2.0 SITE & INTERIM STATUS SYSTEM DESCRIPTION

2.1 INEEL Description

The Idaho National Engineering and Environmental Laboratory (INEEL) site, controlled by DOE, occupies about 890 square miles (2,300 km^2) on the Eastern Snake River Plain in southeastern Idaho, approximately 29 miles (mi) west of Idaho Falls, Idaho (as shown in Figure 2-1). Formerly named the National Reactor Testing Station, the INEEL was established as a site where the DOE could safely build, test, and operate various types of nuclear facilities. The INEEL has also supported other Government-sponsored projects and programs including energy, defense, and environmental and ecological research.

2.1.1 INTEC Description

INTEC is situated on the south-central portion of the INEEL site, as indicated in Figure 2-1, and occupies an enclosed and secured area of approximately 1 km^2 (250 acres). The INTEC has been in operation since 1954, and has historically been a uranium reprocessing facility for defense projects and for research and storage of spent nuclear fuel. Irradiated defense nuclear fuels were reprocessed to recover unused uranium. After fuel dissolution and extraction, the liquid wastes were calcined and the resulting granular solids subsequently stored in stainless steel bins. Depending on the type of fuel reprocessing used, several types of high-level, radioactive liquid wastes have been produced at INTEC.

In 1992, the DOE announced the reprocessing portion of the INTEC mission would be phased out. This decision led to the phaseout of all fuel dissolution, solvent extraction, product denitration, and other processes at the INTEC (WINCO, 1994). Accordingly, the Fuel Reprocessing Complex (CPP-601 and associated buildings -640 and -627) is scheduled to be deactivated. This complex is located in the northwest portion of INTEC as shown in Figure 2-2. There are three RCRA interim status units inside this complex. The units are the CPP-601 WG/WH Storage and Treatment Tanks and associated ancillary equipment, the CPP-640 Headend Process Storage Tanks and associated ancillary equipment, and D cell, a container storage unit.

2.1.1.1 CPP-601

The CPP-601, -640, and -627 facilities were used for reprocessing spent nuclear fuel at the INTEC. The CPP-601 facility was constructed in 1953, and included the separation process, dissolution processes such as the aluminum dissolution system and the zirconium dissolution system, chemical makeup and transfer, and liquid waste receiving processes. The DOE ended nuclear fuel reprocessing at CPP-601 in 1992, and the facility was no longer needed, making it obsolete for the originally intended mission. The Process Equipment Waste (PEW) system collected and chemically adjusted the low-level and intermediate level radioactive mixed waste streams that originated from the various sources located in CPP-601. The four storage tanks which comprise the PEW system (i.e., VES-WG-100, VES-WG-101, VES-WH-100, VES-WH-101) are included on the INEEL RCRA Part A permit and are operated as interim status waste management units.

D cell, located in CPP-601, is an interim status unit for the storage of mixed waste in containers. It has been used as a container storage area since 1989.

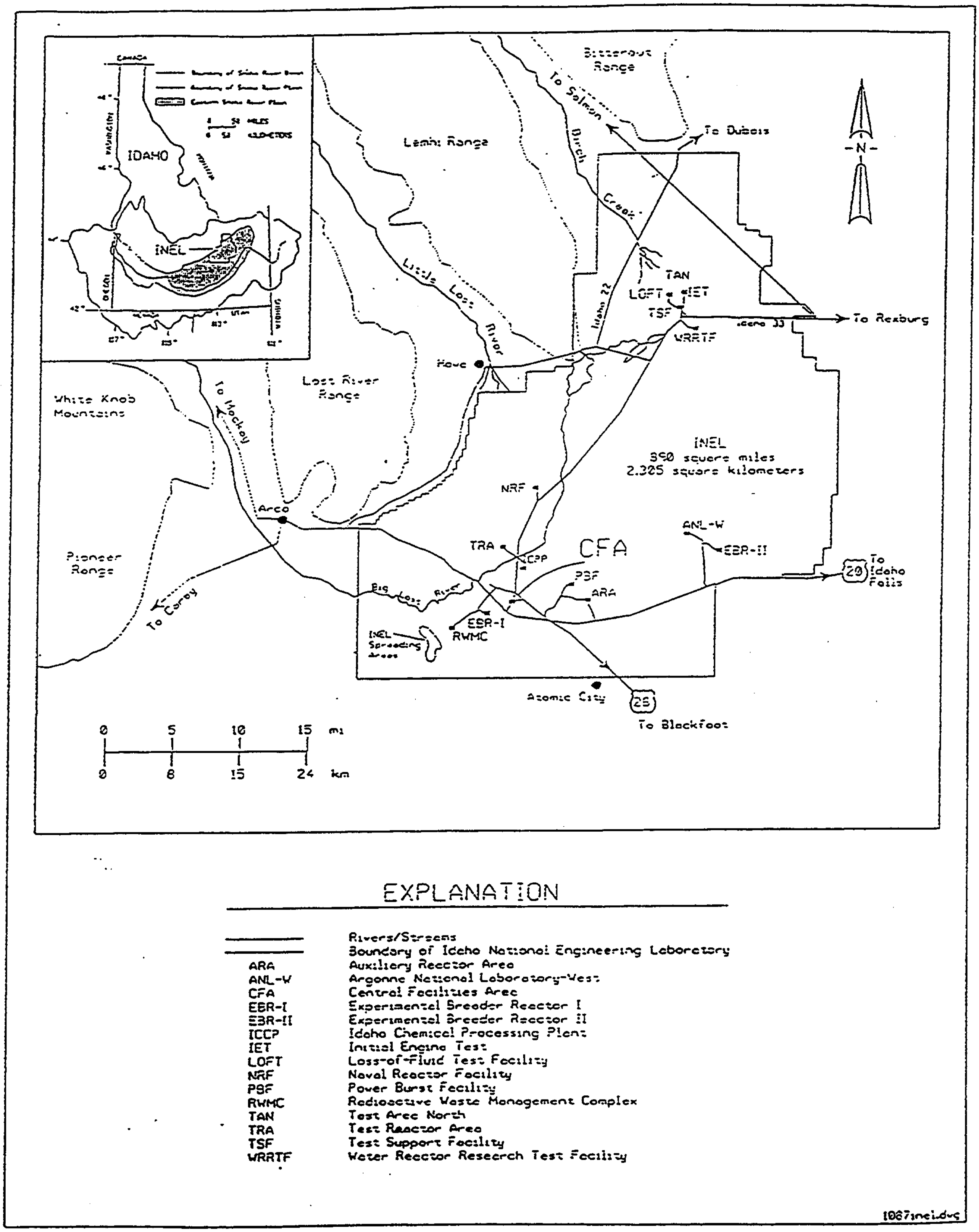

Figure 2-1. Location of INEEL and INTEC.

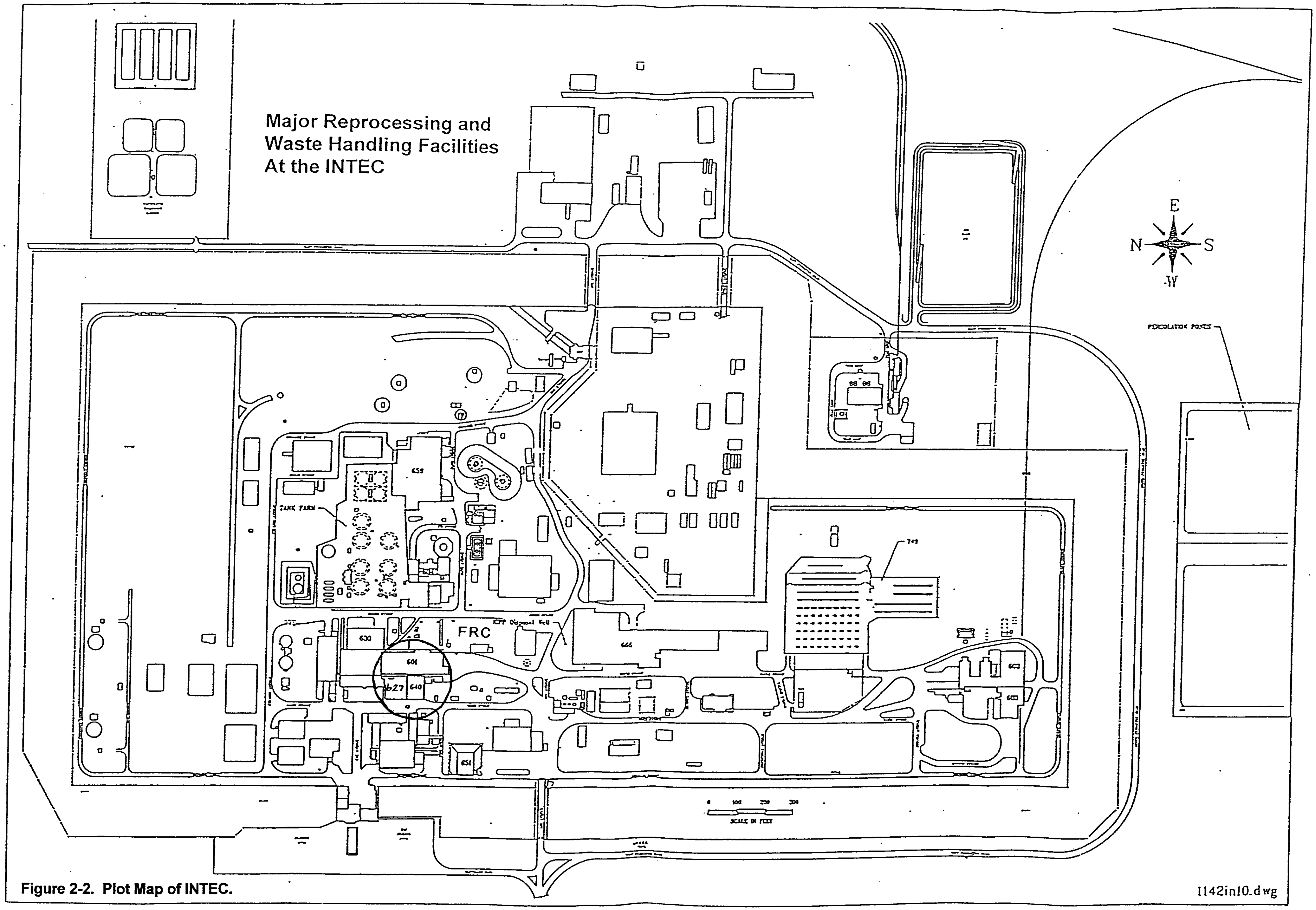

Figure 2-2. Plot Map of INTEC.

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2.1.1.2 CPP-627

CPP-627 is a 14,727 ft^2 facility entirely above ground and is adjacent to and attached to CPP-601. This facility, constructed in1955 of reinforced concrete and masonry block, is currently inactive. CPP-627 included the Hot Chemistry Laboratory (HCL) , the Old Shift Laboratory (OSL), the Remote Analytical Facility (RAF), the Multi-Curie Cell (MCC), the Emission Spectroscopy Lab (ESL), and the Decontamination Development Lab (DDL). The Custom dissolution process was located in the HCL and MCC.

2.1.1.3 CPP-640

CPP-640 was constructed in 1961, with operations beginning in 1963, and included Rover and Electrolytic Dissolution Process (EDP). The DOE ceased operation of the Rover and EDP processes in 1984 and 1981, respectively. The majority of the process chemical and radionuclide inventory from the headend systems has been removed, but both systems remain radiologically contaminated. CPP-640 was originally built and designated as a Hot Pilot Plant. It was designed to allow full scale experiments with irradiated fuel to improve processes in the FRC. After the success of Rover and the EDP, the designation was changed to the Headend Processing Plant (HPP). The facility consisted of five shielded cells (a sixth was added for Rover in the 1970's) and a waste collection system. This system collected low and intermediate level waste streams from sources within CPP-640. The wastes were then transferred to the Westside Holdup Storage Tanks in CPP-641. The three tanks associated with the HPP (i.e., VES-HW-100, VES-HW-101, VES-HW-102) are also included on the INEEL RCRA Part A permit and operated as an interim status waste management unit called the Headend Holdup Storage Tanks.

2.2 FRC Operating History

Any description of FRC operations is complicated by the fact that the plant was continuously evolving. The major process description in this document applies to the final configuration of the plant. A brief summary of major process changes will be given here.

Fuel dissolution processes (headends) were added or modified as needed to match the different types of fuel to be processed. Headends were abandoned when specific types of fuel were exhausted or when superceded by improved processes.

CPP-601 was originally built with three extraction cycles, using hexone solvent, in P, Q, and S cells. Batch-type fuel dissolvers were located in A, C, and D cells. A system for extracting Ba-140 from 'green' fuel, the Rala process, was installed in L-cell. New extraction cycles based on tributylphosphate (TBP)/kerosene solvent were later installed in F and G and H cells. The F-cell system was designed to operate with the submarine thermal reactor/submarine intermediate reactor (STR/SIR) dissolution process in E-cell. The G and H cell system was designed to operate with the continuous aluminum dissolvers in G-cell. The TBP/kerosene cycles were then used for first cycle extraction. P and Q cells were modified to serve as second and third cycles (hexone). The extraction cycle in S-cell was abandoned, along with the batch dissolvers. The electrolytic dissolver (EDP) in CPP-640 replaced the SIR dissolver, and the addition of nuclear poison to the STR process allowed it to use the G and H cell extraction system. The F-cell extraction system and B-cell product collection tanks were then ripped out. Centrifuges for product clarification were installed in F-cell.

Raffinate collection systems also changed with the extraction cycles. First cycle raffinates were collected in U-cell (from P-cell and Rala), E-cell (from F-cell), and G-cell (from G and H cell). Second cycle raffinates were collected in Y-cell (from Q-cell) and U-cell (from P-cell). Third cycle raffinates were collected in Y-cell (from S-cell and, later from Q-cell). Y-cell was reconfigured from four pairs of aqueous raffinate collection tubes and four pairs of hexone collection tubes to a pair of eight tube raffinate collection banks. The collection banks in U-cell and Y-cell were then connected in series so that the combined second and third cycle raffinates could be given two independent sample points to ensure criticality safety. The raffinate evaporators in U and Y cells were abandoned as unnecessary. Carbonate wash solutions from the TBP/kerosene cycles were originally routed to PEW, but were later routed through U and Y cells like the second and third cycle raffinates.

Hexone was originally collected in W-cell (from P-cell) and in Y-cell (from Q and S cells). Later, all hexone collection was combined in W-cell.

Accountability measurement tanks were installed in M-cell to provide more timely control of nuclear materials. One pair of tanks was inserted into the flow of first cycle product to the N-cell intercycle storage banks. The second pair was inserted into the flow of third cycle product to the Z-cell product storage banks.

The original uranium salvage system, located in J-cell, had serious weaknesses in criticality safety. A density monitor tank, S-116, was installed in S-cell to solve part of this problem. A new, critically safe salvage system was later installed in L and C cells. J-cell was then restricted to the recycle of PEW solutions. S-116 was then reconfigured to serve as a decanter to prevent TBP from reaching the L and C cell salvage system.

The original final product was liquid uranyl nitrate, which was loaded into bottles in the CPP-602 basement. A fluidized bed denitrator that produced granular solid uranium trioxide replaced this system. The denitrator was also located in the CPP-602 basement.

The following timeline summarizes significant events during the operation of the FRC.

Timeline of ICPP Fuel Processing Operations

1953	First fuel dissolved in CPP-601 (batch Aluminum in C&D cells, P, Q, S hexone cycles, operated as I, II, III cycles)
1954	EBR-I core 1 dissolved (Stainless steel, A-cell (only known use of A-cell))
1955	RAF and MCC completed in CPP-627
1957	First Rala dissolution (Ba-140 production, L-cell)
	First STR dissolution (zirconium in E-cell, F-cell TBP I-cycle)
	First continuous Aluminum dissolution (G-cell, G&H-cell TBP I-cycle)
1959	First SIR dissolution (stainless steel in E-151, F-cell TBP I-cycle)

	First criticality accident, in WG cell PEW tank; caused by uranium solution siphoning from safe geometry storage bank in B-cell
1961	Second criticality accident, in H-cell evaporator; caused by pressurized air lifting uranium solution from safe geometry evaporator body into unsafe geometry disengaging head
1962	Hot Pilot Plant completed in CPP-640
1963	Last Rala run
1965	Last SIR run, last use of F-cell TBP I-cycle
	First fuel dissolution in CPP-640 (Snaptran core debris)
	First fuel dissolution in CPP-627 MCC (EBR-1, core 2)
	First Zirconium process using nuclear poison
1966	Begin accumulation of solution for Np/Pu recovery demonstration project.
1969	First Co-processing campaign (simultaneous dissolution of zirconium in E-cell, aluminum in G-cell; G&H-cell TBP I-cycle). Hexone cycles in P, Q, S now run as II, III, IV cycle.
1971	First use of product Denitrator.
	Last use of C&D-cell batch dissolvers
1971-2	Completed processing and shipment of Np/Pu product.
1973	First Electrolytic dissolution (stainless steel fuel in HC5, CPP-640)
1976-7	Ripout of F-cell TBP cycle, installation of F-cell centrifuges
1978	Third criticality accident, in H-100 scrub column, caused by using out-of-spec dilute scrub solution, allowing uranium to accumulate in unsafe geometry column. Beginning of two-year process shutdown.
1979	Ripout of S-cell hexone cycle (IV-cycle). Installation of S-116 system.
1980-1	Operations resume. Last E-cell zirconium run.
1981	Last Electrolytic run
1982	Begin installing M-cell accountability measurement tanks
1983-4	Rover campaign (graphite fuel in MHC and HC2), last fuel dissolution in CPP-640
	Ripout of original equipment in A, B, C, D, and L-cells

1985-6	Last aluminum fuel campaign, last fuel dissolved in CPP-601.
1986	New uranium salvage system installed in L&C-cells
	First FDP campaign (zirconium fuel dissolution in CPP-666)
1987-8	Second FDP campaign. Last fuel dissolved in CPP-666, last use of G&H-cell TBP cycle
1988-9	Major decontamination of CPP-601 for maintenance and construction
	Begin storing calcine containers in D-cell
1990-1	Buried waste line replacement project. CPP-601 and CPP-627 custom process brought into RCRA compliance. RCRA compliant waste line installed for HW-102 in CPP-640. Ceased use of buried lines under CPP-640. Buried lines under CPP-601 and CPP-627 capped.
1991	Last custom process run. Last uranium dissolution in CPP-627
1992	Termination of reprocessing mission
1993-4	Final II-III cycle process run, uranium sweepdown.
	RCRA compliant waste drains installed in CPP-627 and CPP-684 laboratories.
1993-on	RCRA flushing of CPP-601, CPP-666, and CPP-640.
1994	Final Denitrator run.
1995	I-cycle raffinate line capped in U-cell and G-cell. RCRA compliant drain installed from E-cell sample cubicle to E-153.
1996-7	Denitrator uranium sweepdown and RCRA flushing
1997-8	Rover uranium recovery (CPP-640). No liquids used. RCRA hazardous material (stainless steel cutting fines) removed or immobilized in remaining vessels by grout.

2.2.1 CPP-601 Operating History

CPP-601 contains chemical processing equipment that was used to recover uranium from nuclear fuel. The facility is essentially rectangular (244 ft. by 102 ft.) and consists of five levels with the primary portion located below ground. The top level is above grade and contains an open area that was utilized for transfer of the fuel elements to the process equipment, and for chemical storage, makeup, and transfer. It is constructed of transite panels (containing asbestos). The lower levels, constructed of steel reinforced concrete, contain 29 process cells, numerous corridors, and auxiliary cells that house various equipment and controls. The largest cell (N-Cell) is approximately 57 x 19 x 38 ft., with the remaining cells' dimensions being approximately 20 ft. square by 28 ft. high. The floor, walls of each cell, and equipment is lined or comprised of stainless steel. Most of the processing equipment in the building is enclosed in the heavily shielded cells, which were designed for remote operations.

The waste collection system consists of four 4,500-gallon (gal.) capacity stainless-steel tanks located in two concrete vaults at the lowest level of the building. The INEEL designations for these tanks are VES-WG-100, VES-WG-101, VES-WH-100, and VES-WH-101. These tanks collected waste generated during fuel reprocessing from the CPP-601 separations processes. Other sources, which could send waste to these tanks, include chemistry labs in CPP-602, -627, and -684. These sources entered the system through the lab drains. Process systems in CPP-627, -640, and –666 could also send waste to the WG/WH tanks.

This facility, constructed in 1953, is currently in surveillance and maintenance status. Figure 2-3 shows an expanded view of the FRC and location of the RCRA interim status units.

2.2.1.1 D Cell

D cell is approximately 20 ft long, 19 ft wide, and 28 ft high. The steel reinforced concrete floors are lined with stainless steel with a 10 ft stainless wainscot on the walls. It is a shielded, locked cell with access allowed only by an approved Radiation Work Permit. Beginning in 1989, the container storage area in D cell has been used to store casks of calcine-contaminated waste. The casks are loaded with calcine or other calcine-contaminated materials in either one-gallon cans with press-fit lids similar to paint cans, or special stainless steel cans designed for remote handling.

The containerized waste stored in the casks is a dry granular material, vitrified material (glass-like), or a glass ceramic. Approximately 25 kilograms (kg) of calcine are presently stored in three Calcine Sample Storage casks located in the D cell. Two of the casks each contain approximately 10 kg of calcine. One cask contains approximately 5 kg of calcine and approximately 10 g of calcine material that has been vitrified. These three casks are the only containers of mixed waste that have been stored in D cell during its operational life as a container storage unit.

2.2.2 CPP-640 Operating History

CPP-640, also known as the HPP, contains approximately 15,000 ft^2 of floor space and houses two unique spent fuel headend processing systems, Rover and the EDP, and a liquid waste collection system. The waste collection system consists of three 500-gal. capacity stainless-steel tanks located in two concrete secondary containment vaults (cells) at the lowest level of CPP-640. The INEEL designations for these tanks are VES-HW-100, VES-HW-101, and VES-HW-102. Tanks VES-HW-100 and VES-HW-101 are located together in one cell referred to as the Hot Tank Vault, while tank VES-HW-102 is in a separate, but adjacent cell referred to as the Cold Tank Vault.

The tanks were designated as "hot" (VES-HW-100) and "warm" (VES-HW-101) according to the relative level of radioactivity in the wastes they received and/or the origin of the waste. Tank VES-HW-102 has been designated a "cold" tank since it received only non-radioactive waste. VES-HW-100 collected wastes from Cell 5 (decontamination solutions from the floor sump, fuel charging table drain, and sample station drain), the Centrifuge Wash Tank (VES-HC2-108) in Cell 2 (Rover), and the Cell 2 Sample Station drain. VES-HW-101 collected waste (mostly decontamination solutions) from the surge tank in Cell 5 and the Cell 5 labyrinth drain. VES-HW-102 collected waste from its own vault sump, safety shower drains, and access

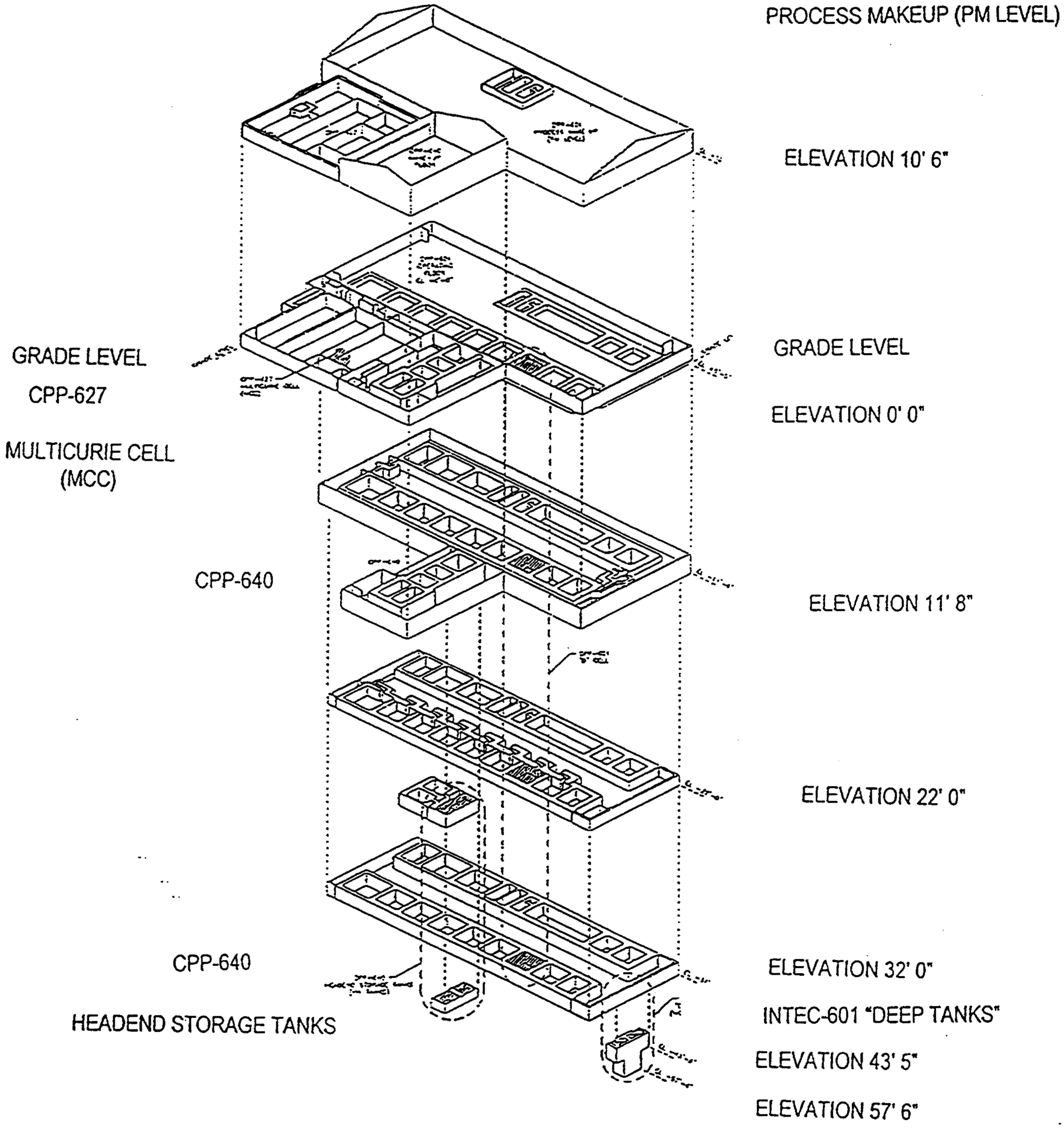


Figure 2-3. Expanded view of the Fuel Reprocessing Complex and location of the RCRA interim status units.

corridor floor drains. The tank could collect non-hazardous waste from other areas which normally flow directly to the service waste monitoring station in CPP-796. These included the floor drain in the HPP process makeup area, condensate from the HPP heating and ventilation system, non-radioactive cooling water, and steam condensate from the process cells in CPP-601.

The two chemical process operations which were the primary source of waste fed to the HPP collection system, Rover and EDP, have been suspended since 1984 and 1981, respectively. Wastes collected in these tanks were transferred to the Westside Waste Holdup Storage Tanks prior to transfer to PEW evaporator facility for treatment or to the Tank Farm for storage. The facility, constructed in 1961, is currently in surveillance and maintenance status.

2.2.3 CPP-627 Operating History

CPP-627 was constructed in 1955 to house analytical, experimental, and decontamination facilities. The northern third of the building housed the analytical facilities. The RAF, consisting of two lines of shielded glove boxes for remote sample preparation and analysis occupied the ground floor. The OSL which occupied the second floor, provided bench and hood space for chemical analyses. Analytical services were provided around the clock to support fuel processing operations.

The middle-third of the building was a high bay decontamination facility, providing space for water and chemical cleaning of contaminated equipment. The decontamination facility was replaced in 1980 by the new decon cell at the New Waste Calcining Facility (NWCF). The original equipment was removed and the area was rebuilt into DDL and the ESL. The second story provided a fan and filter loft for handling off-gas from some radioactively contaminated portions of CPP-627.

The southern third of CPP-627 contained two experimental facilities, HCL and the MCC. The HCL consisted of lab benches, hoods, and shielded glove boxes. The MCC was designed for experiments using fully irradiated fuel. Both the HCL and MCC were used for the Custom Fuel Dissolution process. Custom processing ceased in 1992. The entire CPP-627 building was deactivated in 1997.

2.2.4 Regulatory Status

As stated, the FRC (CPP-601/-627/-640) contains three interim status waste management units included in the INEEL Hazardous Waste Management Act Part A Permit Application. These units are subject to the requirements of Idaho Administrative Procedures Act (IDAPA) 16.01.05.009, *Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities* and IDAPA 16.01.05.009 (40 CFR 265 Subpart I and J: Use and Management of Containers and Tanks). The interim status units are the CPP-601 WG/WH Storage and Treatment Tanks, the CPP-640 Headend Process Storage Tanks, associated ancillary equipment, and the D cell.

A rigorous review of the CPP-601, 627, 640 engineering drawings was performed to identify and define all lines and tanks associated with the above interim status units which managed RCRA hazardous waste. A complete identification and description, which includes tabular and diagrammatical information, is included in subsequent sections. RCRA listed hazardous wastes that were managed by this system have been identified in A Regulatory Analysis and Reassessment of U.S. Environmental Protection Agency Listed Hazardous Waste

Numbers for Applicability to the INTEC Liquid Waste System, INEEL/Ext-98-01213, Rev.1, February 1999. This report also identifies where underlying hazardous constituents must be evaluated and land disposal requirements applied.

The listed wastes identified in the report are F001, F002, F005, and U134. Other RCRA wastes which were or could have been managed in the interim status units were characteristic for corrosivity (D002), cadmium (D006), chromium (D007), and mercury (D009).

2.3 FRC System Description

2.3.1 Methodology for Defining System

Each interim status unit was defined by starting with the main collection vessels (WG-100, -101, WH-100, -101 in CPP-601; HW-100, -101, -102 in CPP-640).

Ancillary equipment includes piping, vented pipe manifolds, valves, pumps, samplers, steam or air jets, airlifts, disengaging pots, strainers, demisters, condensers, sumps, funnels, or other equipment designed to transfer waste solutions to or from the collection vessels.

Ancillary equipment was included on the discharge side up to the point where a clear boundary was reached with downstream processes (the PEW Evaporator system in CPP-604, or the CPP-641 collection vessels). On the collection side, ancillary equipment was included up to the point where solutions were normally committed to the PEW waste system. This distinction is blurred in some cases by the possibility of recycle (even the main tanks could be recycled), but recycle of the WG/WH vessels was a rare event. It only occurred when driven by criticality safety considerations, because uranium recovery by that method was always an economic loss.

Plant drawings and process knowledge were used to compile listings of ancillary equipment. The collection network is very widespread, extending to include buildings CPP-602, -627, -666, and –684, in addition to CPP-601 and -640. All known abandoned portions of the system were included in the listings.

A complete list of tanks and ancillary equipment for the interim status units is contained in Appendix A, Tables 1 through 6, to this document. Table 1 is a list of piping and equipment associated with the CPP-601 tanks VES-WG-100, VES-WG-101, VES-WH-100, and VES-WH-101. Table 2 is a list of piping associated with the sources in CPP-627, which feed to the CPP-601 tanks. Table 3 is a list of piping and equipment associated with the CPP-640 tanks VES-HW-100, VES-HW-101, and VES-HW-102. Tables 4 through 6 list piping and equipment associated with sources in CPP-602, -666, and -684 which feed to the CPP-601 tanks. The tables list individual tanks, pieces of equipment and sections of pipe, and are divided into columns which contain different types of information regarding the interim status units. Service, Status, and Solution Type codes are explained in Section 2.3.1.1. The last two columns in the tables specify past activities conducted on the system, which satisfy the proposed closure performance standards and proposed future closure activities.

A similar process was used to define process tank systems. Tables 7 through 26 describe the VCO tanks and other miscellaneous tanks and piping that are also in the FRC. These tables are in the same format as Tables 1 through 6 and are also included in Appendix A. The VCO tanks are specifically identified as such. Table 2-1 lists each of the tables and includes all equipment covered by each table. The plant drawings used to compile the tables are listed in Appendix B.

2.3.1.1 Classification

Equipment listed in Appendix A (Tables 1-26) was assigned a service code to describe its function, a status code to describe its present operational condition, and a solution type code to describe the type of waste it has contained. A code was also assigned to some sections of pipe to show which lines are buried. The codes will be explained in more detail below.

Service codes:

1. Primary solution flow - equipment in the main flow of solution collection, transfer or storage.

2. Crossovers or recycle - secondary flows involved in inter-tank transfers, return to process, or bypass of failed equipment.

3. Secondary containment - floor drains, sumps, drip pans, and equipment used to return leakage to collection and storage. During operation, leaked solutions were transferred to the uranium salvage system in L-Cell. During decontamination efforts, external decon solutions were collected in the floor sumps for transfer to PEW.

4. Chemical addition lines - equipment to deliver non-radioactive solutions of acid, water, or decontamination chemicals.

5. Abandoned line - equipment removed from service prior to termination of the INTEC uranium processing mission. Much of this equipment was removed from service prior to implementation of RCRA requirements; flushing/emptying was done only to satisfy criticality safety requirements.

6. Sample system - equipment used to obtain samples from collection vessels or flowing streams.

7. Off-Gas systems - systems used to control contamination by keeping process cells, vessels, and samplers under vacuum. Both from a process operation and safety viewpoint, liquids were not desired in off-gas systems, so all off-gas systems were designed to make it difficult to introduce liquid. However, process malfunctions, operator errors, and inadequately controlled temperatures could cause vapors and mists to collect in the off-gas piping, so all systems were equipped with drains. These drains are listed as primary waste collection points, even though most off-gas piping is dry.

8. Administratively Out of Service - equipment removed from service by procedure or tag-out because physical isolation was not practical.

Table 2-1
Guide to Equipment Description Tables

1. CPP-601 PEW Collection (CPP-601 **WG, WH, WT, PT, WJ, WK, VT, PA, A, B, C, D, E, F, G, H, J, K, O, P, Q, R, S, U, W, X, Y, PM, SJ, SK; *CPP-640* HV)**

- Active waste collection vessels
  - VES-WG-100
  - VES-WG-101
  - VES-WH-100
  - VES-WH-101
- Floor sumps
  - SU-B-108 (VCO)
  - SU-C-112
  - SU-D-112
  - SU-F-120
  - SU-G-117
  - SU-H-121
  - SU-J-121
  - SU-K-107 (VCO)
  - SU-PA-111
  - SU-P-113
  - SU-Q-113
  - SU-S-113 (VCO)
  - SU-U-132 (VCO)
  - SU-W-131 (VCO)
  - SU-Y-142 (VCO)
  - SU-PT-101
  - SU-PT-102
  - SU-PT-103
  - SU-HV-100 (VCO)
  - SU-VT-109 (VCO)
  - SU-VT-110 (VCO)
  - SU-WJ-101 (VCO)
  - SU-WJ-102 (VCO)
  - SU-WK-104 (VCO)
  - SU-WK-105 (VCO)
  - SU-WK-106 (VCO)
  - SU-WK-107 (VCO)
  - SU-WK-108 (VCO)
  - SU-WG-102 (VCO)
  - SU-WH-102 (VCO)
  - SU-WT-101 (VCO)
  - Abandoned sump VES-PA-102 (VCO)
- Idle waste collection vessels
  - VES-F-107 (VCO)
  - VES-F-108 (VCO)

Table 2-1
Guide to Equipment Description Tables

1. CPP-601 PEW Collection **(*CPP-601* WG, WH, WT, PT, WJ, WK, VT, PA, A, B, C, D, E, F, G, H, J, K, O, P, Q, R, S, U, W, X, Y, PM, SJ, SK; *CPP-640* HV) (con't)**
▪ Collection headers in waste trench, vent tunnels, and service corridor ▪ Drains from PM area, X-Cell lab, sample corridors, and offgas systems ▪ Drains from sample blisters and cubicles, and from PTS system ▪ Abandoned transfer lines to CPP-604
2. CPP-627 PEW Collection (HCL, MCC, RAF, OSL, DDL)

▪ Abandoned vessel
    ▪ VES-627-103 (VCO)
▪ Abandoned lines under CPP-627
▪ New collection headers (abandoned with building) to CPP-601 PEW
▪ Floor sumps
    ▪ SU-RAF-101
    ▪ SU-RAF-102
    ▪ SU-RAF-103
    ▪ SU-RAF-104
    ▪ SU-RAF-105

3. CPP-640 PEW Collection (HC1, HC2, HC3, HC4, HC5, HA, HS, HW)

▪ Active waste collection vessel
    ▪ VES-HW-102
▪ Out of service waste collection vessels
    ▪ VES-HW-100
    ▪ VES-HW-101
▪ Floor sumps SU-HW-104, SU-HW-106
▪ Out of service collection headers under CPP-640
▪ Out of service transfer lines to CPP-641
▪ Transfer line to CPP-601 PEW

4. CPP-602 PEW Collection (LA, LB, LC, LD)
▪ Abandoned collection headers under CPP-602 ▪ Active collection headers ▪ Sump SU-LC-107 (VCO) ▪ Connection to CPP-601 PEW
5. CPP-666 (FDP) PEW Collection (FA,FC,FD)
▪ Hot waste transfer line to CPP-601 PEW ▪ Cold transfer line to CPP-601 (RCRA closed)
6. CPP-684 (RAL) PEW Collection (RO,RR,RW)
▪ Abandoned lines under CPP-684 ▪ Active collection header under CPP-684 (non RCRA) ▪ Active collection header to CPP-601 PEW (RCRA compliant)

Table 2-1
Guide to Equipment Description Tables

7. Chemical Makeup and Distribution (CPP-601 PM area)

▪ Active chemical makeup & storage vessels
  ▪ VES-PM-100
  ▪ VES-PM-121
  ▪ VES-PM-195
▪ Nitric acid and aluminum nitrate headers
▪ Acid addition to PEW
▪ Decon distribution header
▪ Transfer lines to CPP-604 and –659
▪ Inactive vessels
  ▪ VES-PM-123
  ▪ VES-PM-116-0 (VCO)

8. Aluminum Fuel Dissolution (CPP-601 G-Cell, F-Cell, PM Area)

▪ Idle process vessels
  ▪ VES-G-101 (VCO)
  ▪ VES-G-151 (VCO)
  ▪ VES-G-104
  ▪ VES-G-154
  ▪ G-100 Cave
▪ Airlift transfer system to E-Cell
▪ Idle chemical makeup vessels
  ▪ VES-PM-101-0 (VCO)
  ▪ VES-PM-102-0 (VCO)
  ▪ VES-PM-104-0 (VCO)
  ▪ VES-PM-105-0 (VCO)
  ▪ VES-PM-186 (VCO)

9. Zirconium Fuel Dissolution (CPP-601 E-Cell, PM Area)

▪ Idle process vessels
  ▪ VES-E-101 (VCO)
  ▪ VES-E-106 (VCO)
  ▪ VES-E-104
▪ Inactive makeup vessels
  ▪ VES-PM-117 (VCO)
  ▪ VES-PM-164 (VCO)
  ▪ VES-PM-175 (VCO)
  ▪ VES-PM-180 (VCO)
  ▪ VES-PM-188 (VCO)
  ▪ VES-PM-194 (VCO)

Table 2-1
Guide to Equipment Description Tables

10. Electrolytic Fuel Dissolution (CPP-640 Cell 5, CPP-601 PM area)
▪ Inactive process vessels ▪ VES-HC5-100 (VCO) ▪ VES-HC5-101 (VCO) ▪ Sump VES-HC5-102 (VCO) ▪ Inactive makeup vessel ▪ VES-PM-100-1 (VCO)
11. Rover (CPP-640 HCC, HC1, HC2, HC3, HC4)
▪ Inactive process vessels ▪ VES (or DIS)-HC2-152 (VCO) ▪ VES-HC2-153 (VCO) ▪ VES-HC2-107 ▪ VES-HC2-108 (VCO) ▪ VES-HC2-109 ▪ VES-HC2-110 ▪ VES-HC2-121 (VCO) ▪ CEN-HC2-400 ▪ Cell 2 sump ▪ Abandoned vessels and sumps ▪ VES-HC2-151 (VCO) ▪ VES-HC3-100 ▪ VES-HC3-104 ▪ VES-HCC-106 ▪ Sumps in MHC and Cells –1, -3, -4
12. First Cycle Feed Collection and Adjustment (CPP-601 E-Cell and G-Cell)
▪ Idle process vessels ▪ VES-E-102 (VCO) ▪ VES-E-103 (VCO) ▪ VES-E-108 (VCO) ▪ VES-E-109 (VCO) ▪ VES-E-110 (VCO) ▪ VES-E-153 (VCO) ▪ VES-G-105 (VCO) ▪ VES-G-106 (VCO) ▪ VES-G-108 (VCO) ▪ VES-G-155 (VCO) ▪ Sump SU-E-111 ▪ Inlet manifolds from FDP (CPP-666)
13. Centrifuge System (CPP-601 F-Cell and PM area)
▪ Idle process vessels ▪ VES-F-101 (VCO) ▪ CEN-F-400 (VCO) ▪ CEN-F-401 (VCO) ▪ VES-F-105 (VCO)

Table 2-1
Guide to Equipment Description Tables

13. Centrifuge System (CPP-601 F-Cell and PM area) (con't)

▪ VES-F-106 (VCO)
▪ Idle makeup vessel
  ▪ VES-PM-170 (VCO)
▪ Transfer manifolds to G-Cell
▪ Idle air reservoir
  ▪ TK-PO-121 (VCO)

14. First Cycle Extraction (CPP-601 G-Cell, H-Cell, PM area)

▪ Idle process vessels
  ▪ VES-G-165
  ▪ VES-G-111 (VCO)
  ▪ VES-H-100 (VCO)
  ▪ VES-H-103 (VCO)
  ▪ VES-H-134 (VCO)
  ▪ EVP-H-130 (VCO)
  ▪ VES-H-131 (VCO)
  ▪ HE-H-300 (VCO)
▪ Idle air reservoirs
  ▪ VES-PM-124-0 (VCO)
  ▪ VES-PM-125-0 (VCO)
  ▪ VES-PM-126-0 (VCO)
  ▪ VES-PM-133-0 (VCO)
▪ Transfer manifold to M-Cell
▪ Active Makeup vessels
  ▪ VES-PM-100-0
  ▪ VES-PM-106-0
▪ Idle makeup vessels
  ▪ VES-PM-113 (VCO)
  ▪ VES-PM-107-0 (VCO)
  ▪ VES-PM-108-0 (VCO)
▪ Inactive makeup vessels
  ▪ VES-PM-135-0 (VCO)
▪ Idle ammonia distribution header

15. First Cycle Raffinate Collection (CPP-601 G-Cell and E-Cell)

▪ Idle waste collection vessels
  ▪ VES-G-115 (VCO)
  ▪ VES-G-116 (VCO)
▪ G-Cell portion raffinate transfer line
▪ Abandoned raffinate transfer route to tank farm
▪ Abandoned STR/SIR process vessels
  ▪ VES-E-105
  ▪ VES-E-151 (VCO)
  ▪ HE-E-351
  ▪ Abandoned STR/SIR waste lines to tank farm

Table 2-1
Guide to Equipment Description Tables

16. First Cycle Solvent Treatment and Removal (CPP-601 H-Cell, K-Cell, PM area)

▪ Idle process vessels
  ▪ VES-H-115 (VCO)
  ▪ VES-H-116 (VCO)
  ▪ VES-H-117 (VCO)
  ▪ VES-H-118 (VCO)
  ▪ VES-H-119
  ▪ VES-H-108 (VCO)
  ▪ VES-H-145 (VCO)
  ▪ VES-K-113 (VCO)
  ▪ VES-K-109 (VCO)
  ▪ VES-K-110
  ▪ VES-K-111 (VCO)
  ▪ VES-K-112 (VCO)
▪ Carbonate waste transfer manifold to U-Cell
▪ Solvent transfer to K-Cell via P-PA-237
▪ Solvent transfer to VES-NCE-184 via P-PA-253
▪ Idle makeup and feed vessels
  ▪ VES-PM-109-0 (VCO)
  ▪ VES-PM-110-0 (VCO)
  ▪ VES-PM-111-0 (VCO)
  ▪ VES-PM-112-0 (VCO)
  ▪ VES-PM-113-0 (VCO)
  ▪ VES-PM-115-0 (VCO)

17. Intercycle Product Storage and Accountability Measurement (CPP-601 M-Cell and N-Cell)

▪ Idle process vessels
  ▪ VES-M-101
  ▪ VES-M-102
  ▪ VES-M-103
  ▪ VES-M-104
▪ Sump SU-M-115 (VCO)
  ▪ VES-N-100 (8 tubes)
  ▪ VES-N-110 (8 tubes)
  ▪ VES-N-120 (8 tubes - tube VES-N-125 is VCO)
  ▪ VES-N-130 (8 tubes)
  ▪ VES-N-140 (8 tubes)
  ▪ VES-N-150 (8 tubes)
▪ N-Cell inlet and bottom headers

Table 2-1
Guide to Equipment Description Tables

18. L- and C-Cell Uranium Salvage (CPP-601 C-Cell, L-Cell, Q-Cell, and Service Corridor)

▪ Idle process vessels
  ▪ VES-C-101 (VCO)
  ▪ VES-C-102 (VCO)
  ▪ VES-C-103
  ▪ VES-L-101 (VCO)
  ▪ VES-L-102 (VCO)
  ▪ VES-L-103 (VCO)
  ▪ VES-L-104 (VCO)
  ▪ VES-L-105 (VCO)
  ▪ VES-L-106
  ▪ VES-L-130 (VCO)
  ▪ VES-Q-116
▪ VES-J-123 manifold collection system
▪ Abandoned inlet from MCC
▪ N-Cell bank drip pans
▪ Sump SU-N-164
▪ Sump SU-N-166
▪ Sump SU-L-116 (VCO)

19. Second and Third Cycle Extraction (CPP-601 P-Cell, Q-Cell, PM area)

▪ Idle process vessels
  ▪ VES-P-102
  ▪ VES-P-106
  ▪ VES-P-110
  ▪ VES-P-120
  ▪ VES-Q-102
  ▪ VES-Q-106
  ▪ VES-Q-110
  ▪ VES-Q-120 (VCO)
  ▪ VES-Q-115
▪ Idle Feed pumps
  ▪ P-PA-201
  ▪ P-PA-202
  ▪ VES-PM-268
  ▪ P-PA-203
  ▪ P-PM-204
▪ Idle chemical feed vessels
  ▪ VES-PM-108
  ▪ VES-PM-126 (VCO)
  ▪ VES-PM-110 (VCO)
  ▪ VES-PM-111 (VCO)

Table 2-1
Guide to Equipment Description Tables

19. Second and Third Cycle Extraction (CPP-601 P-Cell, Q-Cell, PM area) (con't)
▪ Inactive makeup vessels ▪ VES-PM-112 (VCO) ▪ VES-PM-124 (VCO) ▪ VES-PM-127 (VCO) ▪ VES-PM-129 (VCO) ▪ VES-PM-130 (VCO) ▪ VES-PM-133 (VCO) ▪ Abandoned process vessels ▪ VES-P-102A ▪ VES-P-106A
20. Second and Third Cycle Raffinate Collection (CPP-601 U-Cell and Y-Cell)
▪ Idle waste collection vessels ▪ VES-U-101 (VCO) (8 tubes) ▪ VES-U-111 (VCO) (8 tubes) ▪ VES-U-121 (VCO) (8 tubes) ▪ VES-Y-101 (VCO) (8 tubes) ▪ VES-Y-121 (VCO) (8 tubes) ▪ Raffinate transfer routes to tank farm ▪ Abandoned vessels ▪ VES-U-129 (VCO) ▪ VES-U-130 (VCO) ▪ VES-U-300 (VCO) ▪ VES-U-301 (VCO) ▪ VES-U-131 ▪ VES-Y-140 (VCO) ▪ VES-Y-300 ▪ VES-Y-150 (VCO) ▪ VES-Y-160 (VCO) ▪ VES-Y-161 (VCO) ▪ Abandoned lines under service corridor floor and in east vent tunnel
21. Hexone Storage, Collection, and Recycle (CPP-601 T-Cell, W-Cell, K-Cell, and PM area)
▪ Idle process vessels ▪ VES-T-100 (VCO) ▪ VES-T-101 (VCO) ▪ VES-T-102 (VCO) ▪ VES-T-103 (VCO) ▪ VES-P-101 ▪ VES-Q-101 ▪ VES-Q-901 ▪ VES-W-101 (VCO) (8 tubes) ▪ VES-W-111 (VCO) (8 tubes) ▪ VES-W-121 (VCO) (8 tubes) ▪ VES-W-129 (VCO) ▪ EVP (or VES)-K-104 (VCO)

Table 2-1
Guide to Equipment Description Tables

21. Hexone Storage, Collection, and Recycle (CPP-601 T-Cell, W-Cell, K-Cell, and PM area) (con't)

  - VES-K-105 (VCO)
  - VES-K-106 (VCO)
- Idle solvent transfer pumps
  - P-PA-209
  - P-PA-210
  - P-PA-212
  - P-PM-213
- Idle makeup vessels
  - VES-PM-114-0 (VCO)
  - VES-PM-131 (VCO)

22. Third Cycle Product Storage and Denitration (CPP-601 Z-Cell, CPP-602 LC area)

- Idle process vessels
  - VES-Z-101 (3 tubes)
  - VES-Z-104 (3 tubes)
  - VES-Z-107 (3 tubes)
  - VES-LC-157 (VCO)
  - VES-LC-158 (VCO)
  - F-LC-160
  - VES-LC-163 (VCO)
- Idle offgas system vessels
  - VES-LC-162 (VCO)
  - VES-Z-120 (VCO)
  - VES-Z-123 (VCO)
- Floor sumps
  - SU-Z-121
  - SU-LC-100 (VCO)
- Acid flush module
- Glove boxes
  - GBX-LC-159
  - GBC-LC-164

23. WG/WH Tank Recycle (CPP-601 J-Cell)

- Idle process vessels
  - VES-J-125 (VCO)
  - VES-J-127 (VCO)
  - VES-J-128 (VCO)
  - VES-J-134 (VCO)
  - VES-J-135 (VCO)
- Abandoned vessels
  - VES-J-117 (VCO)
  - VES-J-131 (VCO)

Table 2-1
Guide to Equipment Description Tables

24. S-116 Decanter System (CPP-601 S-Cell and H-Cell)

▪ Idle process vessels
    ▪ VES-S-116
    ▪ VES-H-113
    ▪ VES-S-117
▪ Abandoned vessels
    ▪ VES-S-115
    ▪ VES-H-120A
    ▪ VES-H-120B

25. CPP-602 Lab Vacuum System (LA, LB, LC)
▪ Idle vacuum vessel ▪ VES-LC-145 (VCO) ▪ Idle vacuum header ▪ Idle vacuum pumps ▪ P-LC-200 ▪ P-LC-201 ▪ Drains to CPP-602 PEW
26. Offgas Systems (CPP-601 SL, VT, WJ, WK; CPP-640 HV; CPP-627 DDL, HCL, RAF)

▪ SOG System
▪ VOG headers
▪ CPM-DOG header
▪ C&D-DOG header
▪ E-DOG header
▪ COG ducts under CPP-627
▪ Abandoned vacuum system in high vacuum cell
    ▪ VES-VT-100
    ▪ VES-VT-101

Status Codes:

A	Active - equipment in current use.
B	Idle Process - equipment in operable condition, but not used because of terminated processing mission.
N	Abandoned - not in operable condition.
C	Capped - cap or plug installed at one or both ends.
X	Excluded from RCRA - equipment did not contain RCRA hazardous wastes. Equipment may include air, steam, chemical, or off-gas piping which was above normal solution levels, and secondary containment where no process leaks or chemical decontamination occurred.
F	Flushed - equipment was flushed three times with water, flushes not sampled.
ST	Sampled for Toxicity - flush solutions sampled for TCLP metals. All found below toxicity characteristic limits.
SP	Sampled for Corrosivity - flush solutions sampled for pH found within non-hazardous range.
FP	Sampled for flash point. No hazardous flash point found.

Solution Type Codes:

From a process view, all PEW solutions were essentially alike. Solution in the collection vessels was strongly acidic and maintained with enough excess acid to allow accidental or intentional addition of caustic decon solutions to be converted to a net acidic condition. Any use of caustic decon agents was followed with an acid rinse, so all parts of the collection system normally contained acidic solutions. Corrosivity characteristic is thus assumed in all PEW solutions.

Process solutions were also corrosive. Hazardous constituents varied depending on the location in the process and the type of fuel being processed. Process vessels were also decontaminated with corrosive decon agents. Stainless steel contains a significant amount of chromium, which is incorporated into the tough surface oxide layer that gives stainless steels their chemical resistance. Chemical decontamination disrupts this oxide layer and frees enough chromium to generate chromium toxicity characteristic in the solution. Chromium toxicity characteristic (D007) must be assumed in all decontamination solutions other than water and dilute nitric acid.

1. pH only - piping known to contain wastes with corrosivity characteristic as the only RCRA concern (D002).

2. Dissolver product from FDP contained cadmium salts. Piping which contained these solutions needs to be checked for cadmium toxicity characteristic (D006).

3. Dissolver product from aluminum fuel processing contained mercury salts. Piping which contained these solutions needs to be checked for mercury toxicity characteristic (D009).

4. Lab listed wastes - in past times, disposal of small amounts of solvents to PEW was permitted. Some of these solvents were F-listed, F005, (benzene, toluene, pyridine, and carbon disulfide). Carbon disulfide breaks down rapidly in a nitric acid environment and presents no concern. The others are highly unlikely to have remained in the system at detectable limits since only small quantities were added over a period of years. The solvents are volatile and many thousands of times their volume of solvent-free waste has passed through the system since the last additions.

   In addition, code U134 has been assigned to lab wastes because small amounts of hydrofluoric acid (HF), after being complexed with aluminum nitrate nonahydrate (ANN), were drained to PEW. Complexed HF from process solutions, physically identical and much greater in quantity, does not carry the U134 code.

5. Solutions which may have contained all of the above hazardous constituents, not necessarily at the same time.

6. Hexone – Equipment contained hexone (methyl isobutyl ketone) as a pure component phase. Pure hexone exhibits hazardous ignitability characteristic (D001), but this characteristic is lost when hexone dissolves in water.

7. HF – Equipment contained uncomplexed hydrofluoric acid. Free fluoride is highly corrosive to stainless steel, so process solutions were always combined with ANN solutions to provide non-corrosive ion complexes.

Buried Line Types

Buried lines, which do not comply with RCRA secondary containment requirements, are designated with the following codes: Most of these lines have been abandoned and capped at one or both ends. Those lines still being used are restricted to non-hazardous service.

& Stainless steel pipe directly buried in soil or in below grade concrete without leak detection capability.

@ Stainless steel pipe in vitreous clay tile.

$	Non-stainless pipe (carbon steel or cast iron) directly buried in soil or in below grade concrete without leak detection capability.

*	Section of pipe connected to a buried line.

#	Buried concrete duct (cell offgas system only)

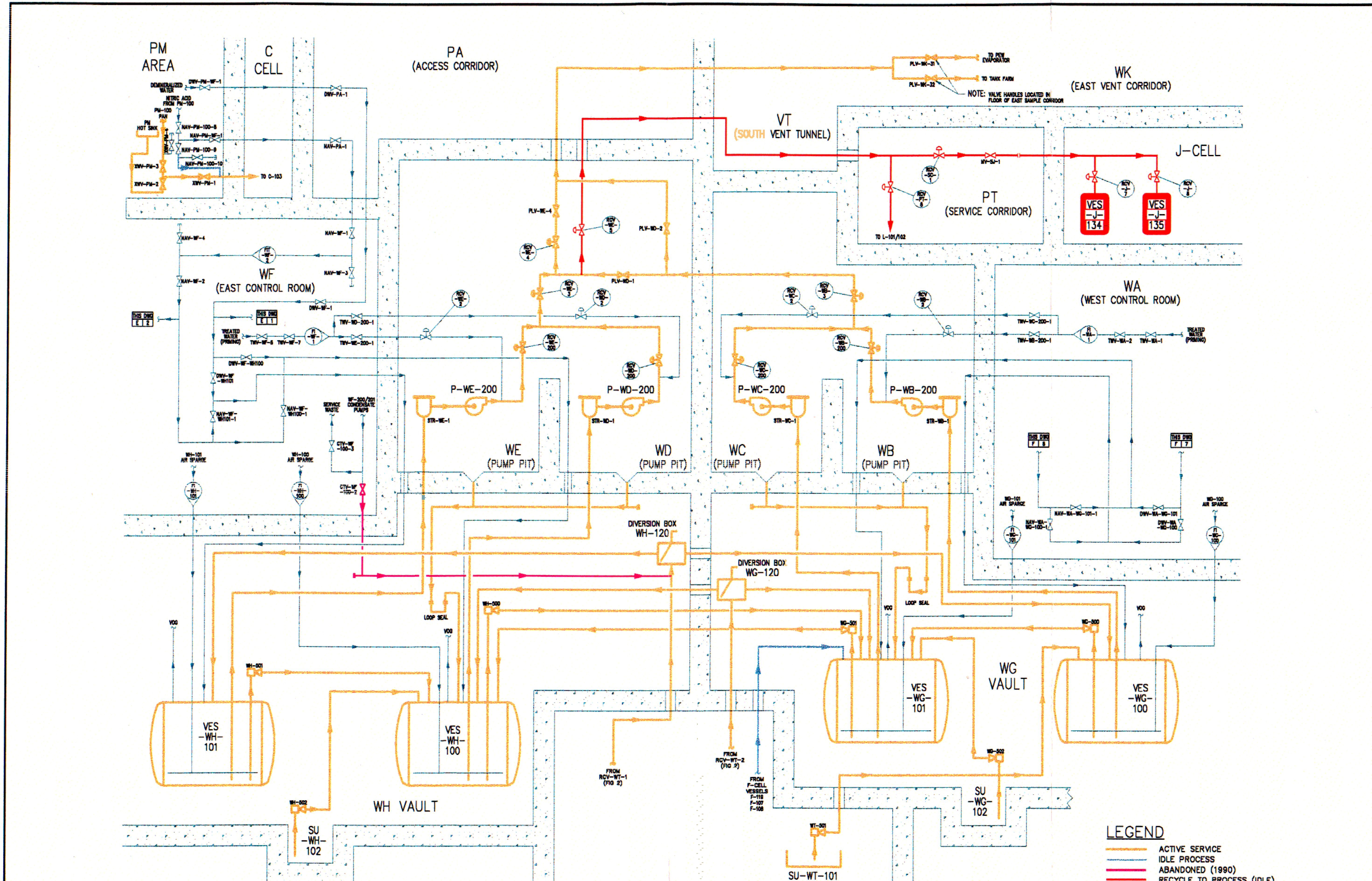
2.3.2 CPP-601 Process Description

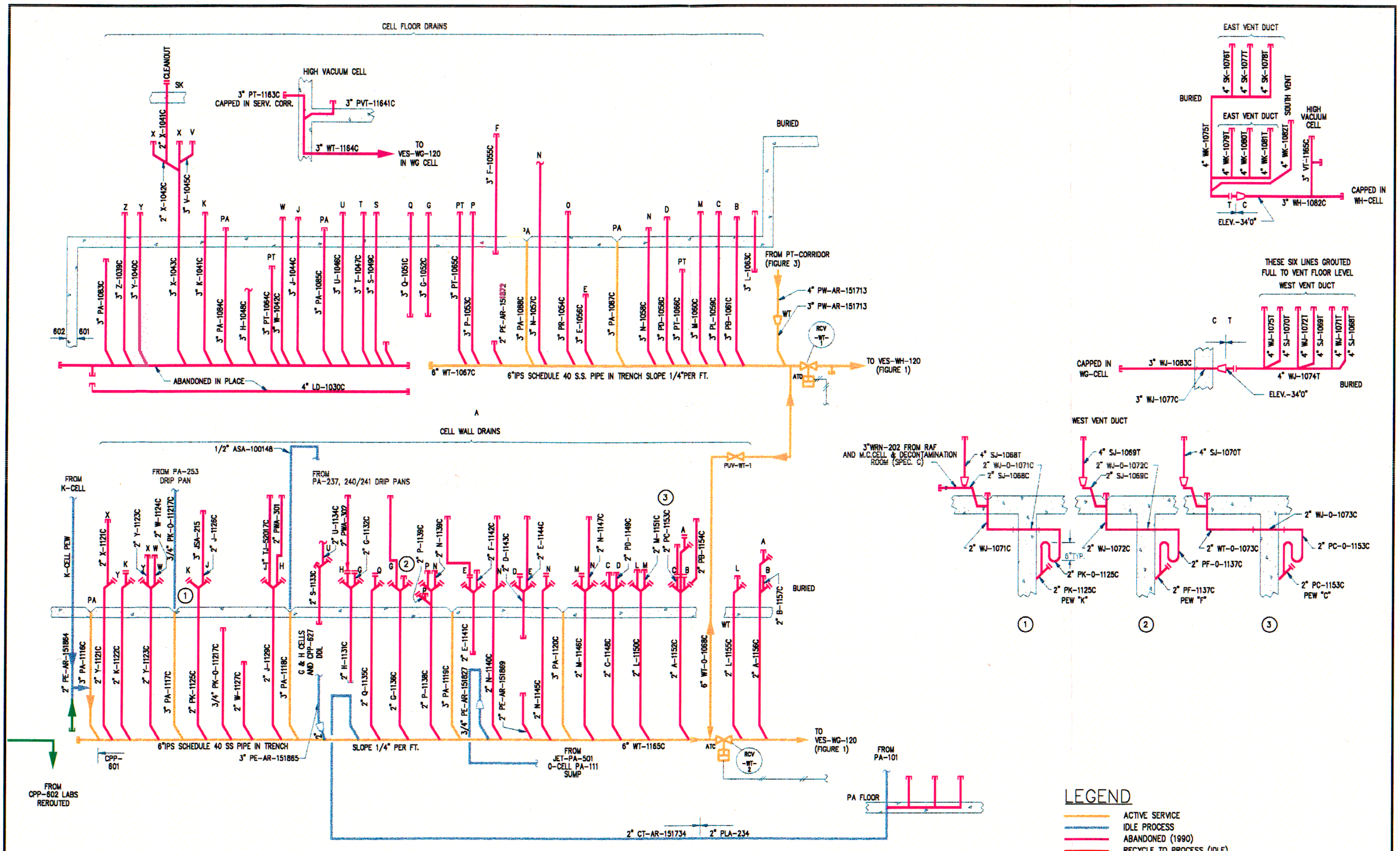
PEW solutions are collected in four 4,500 gallon vessels located in two vaults at the lowest level of the building (hence the common references to the 'deep tanks'). These are vessels WG-100, -101 and WH-100, -101, as shown in Figure 2-4. Waste solutions in these tanks are sampled for uranium accountability. Normally, the solutions are transferred to the PEW evaporator system. The capability exists to transfer solution directly to the tank farm, as was done for centrifuge solids. Rarely, solution was recycled for uranium recovery.

As originally conceived, there were to be two collection systems - a PEW system to collect wastes generated during processing, and a Cell Floor Drain (CFD) system to collect floor drainage and decontamination solutions. The separation proved to be impractical, and within a short time (before 1962) the systems were combined into one PEW collection system, although document references to CFD persisted.

The main collection headers were routed through a waste trench beneath the building (Figure 2-5). The process cells, service corridor, waste trench, and tank vaults were constructed with stainless steel floor liners which extended part way up the walls. The floors were sloped to leak detection sumps, which contained transfer jets for returning solution to the vessels. Process cell floors were constructed with drains to the old CFD header. In many cases the drains posed a criticality risk, so those drains were capped and replaced with jets from the sumps. During operation, solutions collected in floor sumps were transferred to uranium salvage. During decontamination and maintenance activities, floor sumps and drains transferred solutions to the PEW tanks.

The original lines connecting the process cells with the collection headers in the waste trench were directly buried in the soil under the building without secondary containment. These lines were replaced during 1990-91, with new collection headers routed through the service corridor and vent tunnels (Figure 2-6). Where necessary, floors were graded for drainage and provided with leak detection sumps and compatible liners. The old lines were capped. The lines were pitched for gravity drainage and should have been empty. These lines were not flushed because their general integrity was unproved and some leaks were known, and flush solutions could have introduced additional waste to the soil. Also, it would have been very difficult to introduce enough flow to fill and effectively flush the pipes. The buried, abandoned lines are shown in pink in Figure 2-5.


PM AREA
C CELL
PA (ACCESS CORRIDOR)
WK (EAST VENT CORRIDOR)
VT (SOUTH VENT TUNNEL)
J-CELL
PT (SERVICE CORRIDOR)
VES -J- 134
VES -J- 135
WF (EAST CONTROL ROOM)
WA (WEST CONTROL ROOM)
P-WE-200
P-WD-200
P-WC-200
P-WB-200
WE (PUMP PIT)
WD (PUMP PIT)
WC (PUMP PIT)
WB (PUMP PIT)
DIVERSION BOX WH-120
DIVERSION BOX WG-120
VES -WH- 101
VES -WH- 100
VES -WG- 101
VES -WG- 100
WG VAULT
WH VAULT
SU -WH- 102
SU -WG- 102
SU-WT-101
LEGEND
ACTIVE SERVICE
IDLE PROCESS
ABANDONED (1990)
RECYCLE TO PROCESS (IDLE)
TO BE REROUTED AS SHOWN PRIOR TO CLOSURE
FIGURE 2-4



PROCESS EQUIPMENT WASTE SYSTEM

FIGURE 2–5

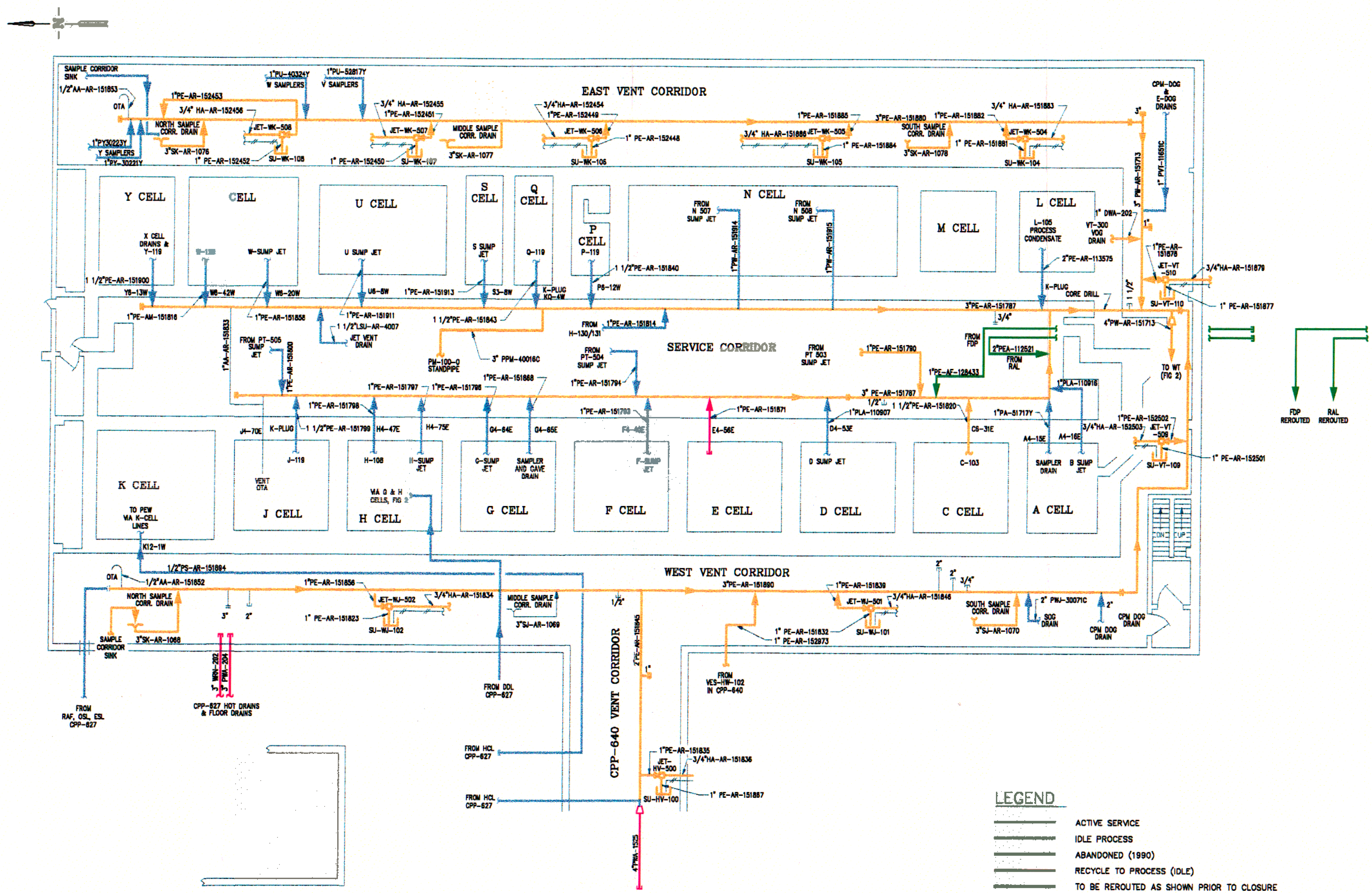

EAST VENT CORRIDOR
SERVICE CORRIDOR
WEST VENT CORRIDOR
CPP-640 VENT CORRIDOR
Y CELL
CELL
U CELL
S CELL
Q CELL
P CELL
N CELL
M CELL
L CELL
K CELL
J CELL
H CELL
G CELL
F CELL
E CELL
D CELL
C CELL
A CELL
SAMPLE CORRIDOR SINK
NORTH SAMPLE CORR. DRAIN
MIDDLE SAMPLE CORR. DRAIN
SOUTH SAMPLE CORR. DRAIN
CPM-DOG & E-DOG DRAINS
TO WT (FIG 2)
FDP REROUTED
RAL REROUTED
FROM DDL CPP-627
FROM HCL CPP-627
FROM RAF, OSL, ESL CPP-627
CPP-627 HOT DRAINS & FLOOR DRAINS
FROM VES-HW-102 IN CPP-640
LEGEND
ACTIVE SERVICE
IDLE PROCESS
ABANDONED (1990)
RECYCLE TO PROCESS (IDLE)
TO BE REROUTED AS SHOWN PRIOR TO CLOSURE

FIGURE 2-6

Description of CPP-601 Processes

Modes of Operation

At least one headend dissolution process was normally operated in conjunction with First Cycle extraction until all storage space for concentrated first cycle product was filled. Headend and First Cycle processes were then shut down. Second and Third Cycle extraction was then started, and the Third Cycle liquid product was converted into solid final product by the denitrator (located in CPP-602). When all solutions were processed, these systems were shut down. The uranium salvage system was nearly always in operation, and could return solutions to either set of extraction cycles. The Custom process could be active at any time. The extraction or headend processes which were not operating could be decontaminated for repairs while other processes were active. Decontamination could take months, and was a major source of PEW solutions.

Sources outside CPP-601, such as the labs in CPP-602, -627, or -684, could send solutions to PEW at any time. Process sources in CPP-640, -627, and -666 could also become active at any time, but the transfers were normally coordinated through CPP-601 operators.

Processes

Fuel Dissolution: Fuel dissolution processes were known as 'headends'. Functional headend processes were located in several buildings with shielded piping connections for transporting the dissolved fuel and liquid wastes to the separations processes in CPP-601.

Dissolvers for aluminum clad fuel were located in G-cell of CPP-601. A dissolver for the older types of zirconium clad fuels was located in E-cell. These systems could be operated independently or in a tandem mode known as co-processing. Co-processing saved significant waste generation by using the dissolved cladding from the aluminum fuel to complex the fluoride from zirconium dissolution. Newer types of zirconium clad fuels were dissolved in FDP cell in building CPP-666. Stainless steel clad fuels were dissolved in Cell 5 of CPP-640 using the Electrolytic dissolver. The Rover process for graphite matrix fuels had dry combustion processes in the Mechanical Handling Cave (MHC) and Cells 3 and 4, and a dissolution process in Cell 2 of CPP-640. A Custom Process located in the CPP-627 HCL was used to dissolve special fuels of small quantity and unique composition. The headends produced uranium solutions, but little PEW during operation.

Dates of Last Headend Operation

Fuel Type	***Last Run***	***Comments***
Aluminum (Batch)	1971	Original process (C&D cells). Equipment removed 1984
Aluminum (continuous)	1986	G-cell was being prepared for operation at termination of reprocessing mission, Used mercuric nitrate
Zirconium	1981	System refurbished 1986, but not used

Fluorinel (FDP)	1988	Was to be the major fuel processed in the future, used cadmium nitrate
Stainless steel (SIR)	1965	Sulphuric/nitric acid dissolution
Stainless steel (EDP)	1981	Run terminated due to equipment failure
Graphite (Rover)	1984	Uranium bearing material recovery completed 1998
Custom	1991	Run terminated due to equipment damage

Feed Collection, Adjustment, and Storage: Dissolver product from the headend processes was collected in vessels located in E- and G-cells. Some processes required chemical adjustment or holding time at elevated temperature prior to being fed to first cycle extraction. Sometimes uranium accountability samples were needed from these vessels. This part of the process did not produce PEW solutions during operation.

Feed Clarification: Headends, like Rover or Aluminum, produced solids which could interfere with extraction column operation. These solids were removed from feed solutions by centrifuges located in F-cell. The separated solids were collected in VES-F-107/108 and flushed to PEW.

First Cycle Solvent Treatment and Removal: First cycle extractant (IAX) consisted of 5 to 10% TBP in kerosene (linear C12, often a proprietary supply such as Amsco or Exxol) diluent. This solvent was separated and sent to a cascade of three mixer-settlers. The first washed with acid (ISW) to remove traces of uranium, the second washed with carbonate solution (IISW) to remove TBP radiolysis products, and the third washed again with acid (IIISW) to remove traces of carbonate. The treated solvent was returned to the process. Small amounts of fresh makeup solvent were added as necessary. At the end of a run, spent solvent could be treated in the K-109 steam stripper. Pure diluent was used as a wash (D-column wash, IDW) in the last column to remove traces of TBP and radiolysis products prior to the first cycle evaporator. This solvent was also collected and treated in the K-109 steam stripper. The processed spent solvents (non-hazardous for RCRA flammability characteristic) were transferred to storage vessels NCE-184, -185, and -186 to await use in NWCF as a combustion agent. Aqueous condensate from K-109 was routed to PEW. Periodically, K-109 was cleaned with a caustic wash, which also went to PEW. The acid wash from the third mixer settler (IIISW) was routed to PEW.

First Cycle Extraction: First cycle extraction consisted of a feed system (G-106 and G-165), four pulsed columns (G-111, H-100, -103, -134), and a product evaporator system (H-130, -131). Uranium was extracted into the IAX solvent in the first column, leaving the bulk of the fission products and dissolved cladding to be disposed as the first cycle raffinate stream. The uranium/solvent stream was scrubbed in the second column, and the used scrub was sent as feed to G-165. The uranium was returned to an aqueous phase by stripping (C-column extractant, ICX) in the third column. Used solvent was routed to the previously described solvent cleanup system. The fourth column used diluent (IDW) to remove traces of organics from the evaporator feed. The first cycle evaporator concentrated the uranium product to 250 to 350 grams of U-235 per liter. The concentrated first cycle product was transferred to M-cell for uranium accountability measurement. The overheads from the evaporator were condensed and routed to PEW. When necessary, the evaporator was flushed with caustic to remove silica deposits. The flush solutions were also routed to PEW.

First Cycle Raffinates: First cycle raffinates were collected in vessels G-115 and -116. Solutions were sampled for uranium accountability before transfer to the tank farm. When necessary, solution could be recycled as feed to the extraction columns. Carbonate wash solutions from the second mixer settler (IISW) were collected in U-cell vessels U-101, -111, -121 for uranium accountability sampling. These solutions were then routed to the tank farm via Y-cell. Solutions from these sources were too radioactive for treatment in the PEW evaporator system in CPP-604.

Intercycle Storage and Uranium Accountability Measurements: Concentrated first cycle solutions were measured for uranium accountability in vessels M-103 and -104. They were then stored in the six N-cell banks to await processing through the second and third extraction cycles. Concentrated product from third cycle was returned to vessels M-101 and -102 for accountability and product purity measurements. Third cycle product could be recycled when necessary, but was normally transferred to Z-cell as denitrator feed. The four M-cell vessels could be used to store concentrated uranium solutions when necessary. Because the potential for uranium loss was so high, nearly all waste solutions from N- and M-cells were transferred to the uranium salvage system. The single exception was removal of water used to verify the depth of borated glass Raschig rings on the N-cell floor. By switching the position of blinds in the transfer lines from the sump jets, this test water could be transferred to PEW.

Uranium Salvage: Solutions known or suspected to contain recoverable amounts of uranium were routed to the uranium salvage system in L- and C-cells. All solutions jetted from floor sumps during process operations were sent to uranium salvage. Condensate from the denitrator and any other solutions generated during second and third cycle operation were also sent to salvage. The L-130 evaporator was used to concentrate salvage solutions. Overheads from this evaporator were condensed, any hexone phase was removed in the L-105 phase separator, and the aqueous condensate was routed to PEW. Hexone was collected in L-106 for return to the solvent system via W-129. Concentrated salvage solutions could be transferred directly to the critically safe vessels in N- or M-cell. When desired, solutions could be transferred to PEW or first cycle. To ensure criticality safety, all such solutions were sampled for uranium content in an L-cell vessel, then transferred to vessel C-101 where a second sample was taken. If both samples showed safe levels of uranium, the solution could be transferred to the large diameter vessels in first cycle or to PEW.

WG/WH Tank Recycle: On rare occasions, the uranium content of a PEW collection tank required recycle for uranium recovery. Recycle routes existed to both J-cell and L-cell. The direct route to L-cell was never used. The J-cell system consisted of two feed collection tanks, the J-125 evaporator, and two product collection tanks. The J-cell collection vessels relied on borated stainless steel poison plates to provide criticality safety, so the solution concentrations from the evaporator were administratively limited to approximately 100 grams per liter uranium. Product solutions could be concentrated further in L-cell. Overheads from the J-125 evaporator were condensed and routed to PEW.

S-116 Decanter System: Salvage operations in L- and C-cells were compatible with hexone solvent, but not with first cycle TBP/diluent solvents. Solutions to be processed for uranium salvage, but which might contain first cycle solvents, were routed through the S-116 decanter system. Separated solvents were returned to the H-cell mixer/settler cascade for reuse. Solvent free solutions were transferred to L-cell for salvage or disposal. This process did not generate PEW solutions.

Second and Third Cycle Solvent Treatment and Storage: Hexone (methyl isobutyl ketone or MIBK) was used as the extraction solvent for second and third cycles. T-cell contained the hexone storage tank, T-100, and feed tanks and pumps to deliver hexone to the extraction columns. Used hexone from both cycles was collected in vessel W-121 and sampled for uranium in vessels W-101 and -111. The used hexone was stored in vessel W-129 for feed to the solvent treatment system in K-cell. Makeup hexone was added to W-129 from an underground tank, VES-YDA-106. This tank and it's associated buried lines were removed prior to 1992. Hexone was distilled in K-104, and the condensing solvent was washed with caustic (10% NaOH) in the plate column section of the still. Aqueous from K-104 drained to PEW. The overheads from K-104 were condensed, collected in vessel K-106, and pumped back to T-100. Water removed in the phase separator K-105 or in the K-106 heel was transferred to PEW.

Second and Third Cycle Extraction: First cycle product was pumped from N-cell to the Clarkson Feeder (PM-268) located above P-cell. These pumps, as well as the pumps between second and third cycles were located in O-cell. From the Clarkson Feeder, solution was routed to column P-102. The columns in Second and Third Cycle were packed with stainless steel Raschig rings. The first column of each cycle (P-102, Q-102) combined the extraction and scrubbing functions found in the first two columns of First Cycle. Hexone from T-cell was pumped to the bottom of the column, scrub solution was pumped in at the top of the column, and the uranium feed was introduced near the middle. The aqueous raffinates were routed to U-cell for collection. The hexone/uranium stream from the first column flowed to the second column (P-106, Q-106), where the uranium was stripped back into the aqueous phase with dilute nitric acid. The uranium stream next went to a product evaporator, while used hexone was routed to W-cell. The evaporator (P-110, Q-110) concentrated the uranium to 350 - 420 grams per liter. Overheads from the evaporator were condensed and routed to PEW. The concentrated Second Cycle product was pumped to Q-cell, where the Third Cycle process was nearly identical to Second Cycle. Third Cycle product was collected in Q-115 for transfer to M-cell for accountability measurement.

It was possible to use the Second Cycle evaporator, P-110, to concentrate any dilute solutions in N-cell. The stream from the Clarkson Feeder could bypass the columns and feed the evaporator directly. The concentrated solutions could be pumped back to M-cell for measurement and return to N-cell storage. Evaporator overheads from this operation also went to PEW.

Any solution draining from the off-gas systems in N-, P-, or Q-cells was collected and sampled in vessel Q-116. This solution was normally routed to uranium salvage, but could be sent to PEW.

Second and Third Cycle Raffinates: The aqueous raffinates from Second and Third cycles were collected as a single stream in one of the three critically safe U-cell banks, U101, -111, or -121. Each bank was sampled for uranium accountability. If uranium limits passed, the solution was transferred to one of the pair of critically safe Y-cell banks, Y-101 and -121. If the sample taken in Y-cell also passed uranium limits, the raffinates were transferred to the tank farm. (During First Cycle operations the same banks were used for carbonate solutions from solvent treatment.) Raffinate solutions were too high in activity for treatment in the PEW evaporator system in CPP-604.

U-cell and Y-cell contain the abandoned evaporators once used to concentrate the raffinates from Second and Third cycles. Y-cell also contained a system which once transferred solutions back to First Cycle, and a collection vessel for returning samples to the process from an old laboratory in X-cell. These vessels were rinsed and checked for residual uranium before their lines were capped.

Z-cell and the Denitrator: Concentrated uranium product solutions were stored in the critically safe Z-cell banks until they could be processed through the Denitrator. The Denitrator used a heated fluidized bed to convert the liquid uranyl nitrate to solid uranium oxide powder. Cans of uranium oxide were packaged for shipment in a glovebox. Vacuum pump Z-202 provided off-gas vacuum for the Denitrator system. Seal water from this pump was routed to PEW. All other solutions from this area were sent to uranium salvage or recycled to M-cell. It should be noted that while Z-cell is located in CPP-601, the Denitrator system is located in CPP-602, and PEW solution was collected in the header below CPP-602.

Inputs from Other Sources in CPP-601: Leak detection sumps in the vent tunnels (HV,VT, WJ, and WK areas) transferred solution to the PEW collection headers. These sumps were installed with the new floors in 1990-91, and no process leaks have occurred since their installation. The HV tunnel is actually in CPP-640, but it opens directly into the CPP-601 west vent tunnel (WJ), and is functionally part of CPP-601.

Solutions entrained in the following off-gas systems drained to the PEW collection headers: Vessel Off Gas (VOG), Sample Off Gas (SOG), Continuous Process Modification Dissolver Off Gas (CPM-DOG), and E-cell Dissolver Off Gas (E-DOG).

Floor drains from the access corridor and the east and west sample corridors led to PEW collection headers. The north drains in each sample corridor included drainage from slop sinks. Two access corridor floor drains included drains from drip pans under pumps and samplers.

The Process Makeup (PM) area hot sink and drip pans under PM-100 drained to PEW via C-cell, and a standpipe in the drip pan under PM-100-0 drained to PEW via the service corridor.

Drains used for flushing the jet vent header led to PEW via the service corridor. Decontamination drains from the pneumatic transfer system (PTS) and from the PTS diverter valve also led to PEW.

Drip pans in most sample blisters and sample cubicles drained to PEW. Exceptions were the L- and M-cell sample cubicle, which drained to the uranium salvage header, and the Z-cell sample enclosure, which drained to LC-163.

The High Vacuum Cell contains abandoned equipment from a vacuum system designed to operate a dissolver product filtration system. Any liquid collected in the vacuum tanks was drained to PEW. The system was highly contaminated and was abandoned in place during the late 1960's.

Extensions of the CPP-601 PEW Collection System

The CPP-601 PEW system also collected solutions from CPP-602, -627, -640, -666, and -684. The CPP-627 and -640 systems are described separately.

CPP-602: CPP-602 houses the Denitrator and a collection of laboratories. The original CPP-602 PEW collection system was patterned after the CPP-601 design, with two headers located in a waste trench beneath the building. CPP-601 and CPP-602 share a common wall; a pit was built on the CPP-602 side to allow the headers beneath CPP-602 to drop to the level of the CPP-601 waste trench. The headers originally were embedded in the wall as they penetrated into the waste trench and connected to the CPP-601 system. The CPP-602 trench was originally unlined concrete, and drains from the basement level laboratories and the Denitrator area were directly buried in the soil under the building.

During 1990-91 the CPP-602 system was upgraded by the same project that brought the CPP-601 system into RCRA compliance. The buried lines were abandoned and capped. The pit at the junction between buildings was partially filled, and a stainless steel liner was installed to convert it into the leak detection sump SU-LC-107. The two collection headers were combined into one, and the new line was routed to the CPP-601 west collection header through a new penetration with secondary containment. A chemically resistant epoxy liner was installed on the floor and lower walls of the waste trench. A new collection header with secondary containment was installed for the basement labs, and the one active line from the Denitrator area was rerouted above the floor.

The current plan calls for the CPP-602 system to remain active. The connection to CPP-601 is to be capped in LC-107, and a new piping system will be installed to transfer PEW solutions to a new collection point, the Westside Holdup Storage Tanks in CPP-641, prior to transfer to the PEW evaporator system in CPP-604.

CPP-666: The FDP could send either hot or cold wastes to PEW or the tank farm. The waste lines were in the same shielded trench as the FDP product lines. Secondary containment was provided by a stainless steel enclosure, which drained to the south Service Corridor sump for leak detection. The hot and cold sources were routed through separate pipes to the CPP-601 Service Corridor. Crossover valves located there allowed selection of the PEW or tank farm destinations. The branch to the tank farm has been physically capped. The cold solution sources, VES-FA-141 and VES-FA-142, underwent RCRA closure in May of 1996. The hot solution sources, jets from the Product Transfer Vessel and the slab tank, transferred into a single waste transfer header. The other possible source, from the product transfer pumps by a remote jumper, was not used because of the difficulty in manipulating the necessary jumpers.

Current plans call for maintaining active status for the transfer capability to PEW from the FDP facility. The waste header will be rerouted to the same PEW collection facility used for CPP-602.

CPP-684: The PEW transfer line from Remote Analytical Laboratory (RAL) to CPP-601 runs in the same shielded trench as the FDP waste and product lines. The original waste collection headers were run in the soil beneath the building. A project completed in 1994 replaced most of the buried piping with new lines and RCRA compliant secondary containment. The abandoned lines were capped as in CPP-601. The remaining buried lines from the cold laboratories are administratively restricted to non-hazardous wastes.

Current plans call for maintaining active status for the RAL collection piping and transfer route to PEW. The waste header will be rerouted along with the line from FDP to the PEW collection facility used for CPP-602.

2.3.3 CPP-627 Process Description

CPP-627: CPP-627 was divided into different functional units. Utilities and waste collection were provided through the CPP-601 facility.

The northern third of CPP-627 was used for radiochemical analysis laboratories. The ground floor held the RAF. This consisted of two lines of shielded glove boxes. The boxes were small, and generally were used for a single sample prep or analysis procedure. Samples were transported between boxes on a remotely operated dolly. Each line had a sample receiving station, and a dumbwaiter to transmit samples between the RAF and the upstairs laboratory. The second floor contained the OSL, which operated in conjunction with the RAF to supply 24-hour analytical services in support of CPP-601 and Calciner operations. The OSL contained gloveboxes and hoods for analysis of samples of low to moderate activity. Liquid wastes from the RAF and OSL were collected in buried stainless pipelines, which were routed to the PEW collection system in CPP-601. Sample residues containing uranium could be routed to the CPP-601 uranium salvage system through another buried pipe.

The middle third of CPP-627 originally contained a decontamination room. Equipment in this room was used for chemical decontamination of items transported from numerous locations at the site. Liquid wastes were collected in buried pipes and routed to the CPP-601 PEW system. The original equipment was removed and replaced with the DDL and the ESL. The new facilities were connected to the old buried waste collection system. Both facilities saw very limited use because of RCRA issues and termination of the reprocessing mission.

The southern third of CPP-627 contained the HCL. This laboratory contained gloveboxes and hoods for radiochemical experiments. It also contained a large walk-in hood used for the Custom Dissolution Process. The MCC was shielded to the equivalent of the CPP-601 process cells to allow remote experiments on irradiated fuel or calcine. The MCC was also used as part of the Custom Process. As in the rest of CPP-627, liquid wastes from the HCL and MCC were collected in buried lines and routed to the CPP-601 PEW. The MCC had a buried line for transporting uranium solutions to the CPP-601 uranium salvage system.

The MCC was to be permitted to store dry calcine for use in research on waste-form development. The project was canceled before any calcine was moved to or stored in the MCC.

Calcine was sampled in the MCC during the late 1970's, but the MCC has been thoroughly decontaminated at least twice since then.

The 1991 Custom Process campaign was terminated after a small explosion in one of the two dissolver vessels. The glass vessel was breached, and dissolver solution contaminated much of the HCL. The dissolver vessels and the walk-in hood were removed, and the HCL was decontaminated.

Originally, all CPP-627 waste piping was directly buried in the soil under the building. These lines were capped and abandoned during the CPP-601 buried line replacement project. During 1993-94 another project installed RCRA compliant PEW drains which connected to the CPP-601 collection system. The entire building was abandoned during 1997, so none of the PEW sources are active. The piping layout is shown in Figure 2-7.

The new piping installed in the HCL and the MCC and routed through CPP-640 was never put into service. The branch serving the DDL has seen only mild corrosive service. The main collection system served the old RAF, the ESL, and the OSL.

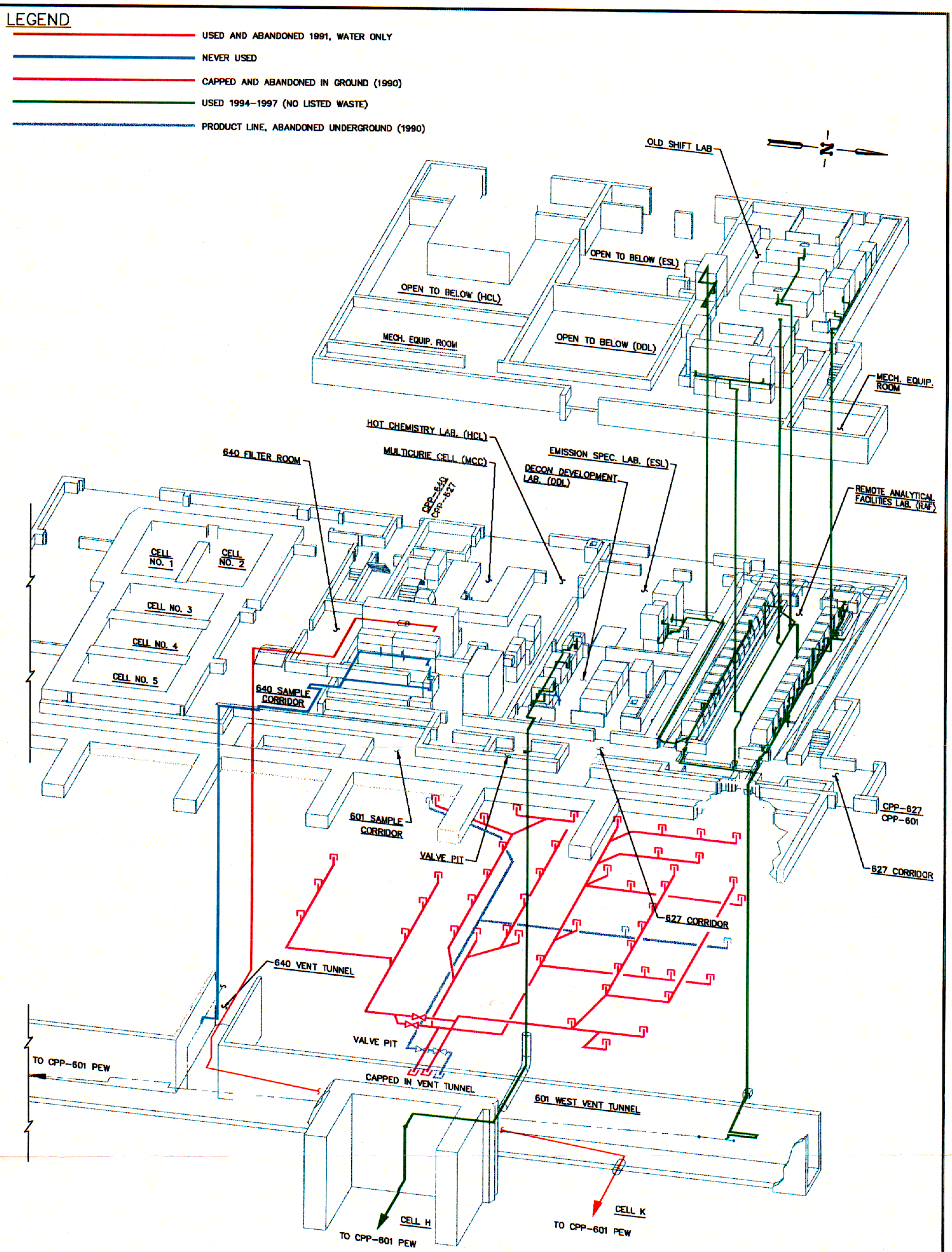
During the 1991 project, a PEW line was installed to serve the Custom process in the HCL. This line was routed through CPP-640. Non-hazardous, used cooling water was the only fluid transferred through this line.

2.3.4 CPP-640 Process Description

CPP-640, originally designated the Hot Pilot Plant (HPP), was designed to test new equipment and chemical flowsheets in support of the fuel processing operations in CPP-601. The facility was built in 1961. The building was constructed as an empty shell with five shielded test cells, shielded waste collection tanks in two vaults at the lowest level of the building, and an open crane loft with space for chemical makeup equipment and removal of cell roof hatches. A major modification in the late 1970s added the shielded MHC for the Rover process within the crane loft.

The facility was designed to allow for maximum flexibility of future test assemblies. Cells 3, 4, and 5 were equipped with two removable shielding walls to allow for possible large tests. Numerous pipe slots through the cell walls (shielded with lead bricks when not in use), and cast-in-place pipe penetrations provided access for instrumentation and control piping and wiring. Cells 1 and 2 were served by a heavy-duty cart capable of transporting casks with irradiated fuel. Fuel charging ports were available at the top of the other three cells. Utility and off-gas services were provided by connections to CPP-601.

The waste collection system also was designed for flexibility, with wall drains and floor drains leading to waste collection headers for the three 500 gallon waste tanks. The tanks and collection piping are shown in Figure 2-8. Secondary containment in the cells and MHC was provided by stainless steel liners covering the floors and the lower portion of the walls. Prior to 1970 the floor drains in the process cells were blocked and converted to sumps. No secondary containment was provided for the waste collection piping, which was run in the soil beneath the building.



CPP-627 WASTE PIPING ANCILLARY TO CPP-601 PEW TANKS

FIGURE 2-7

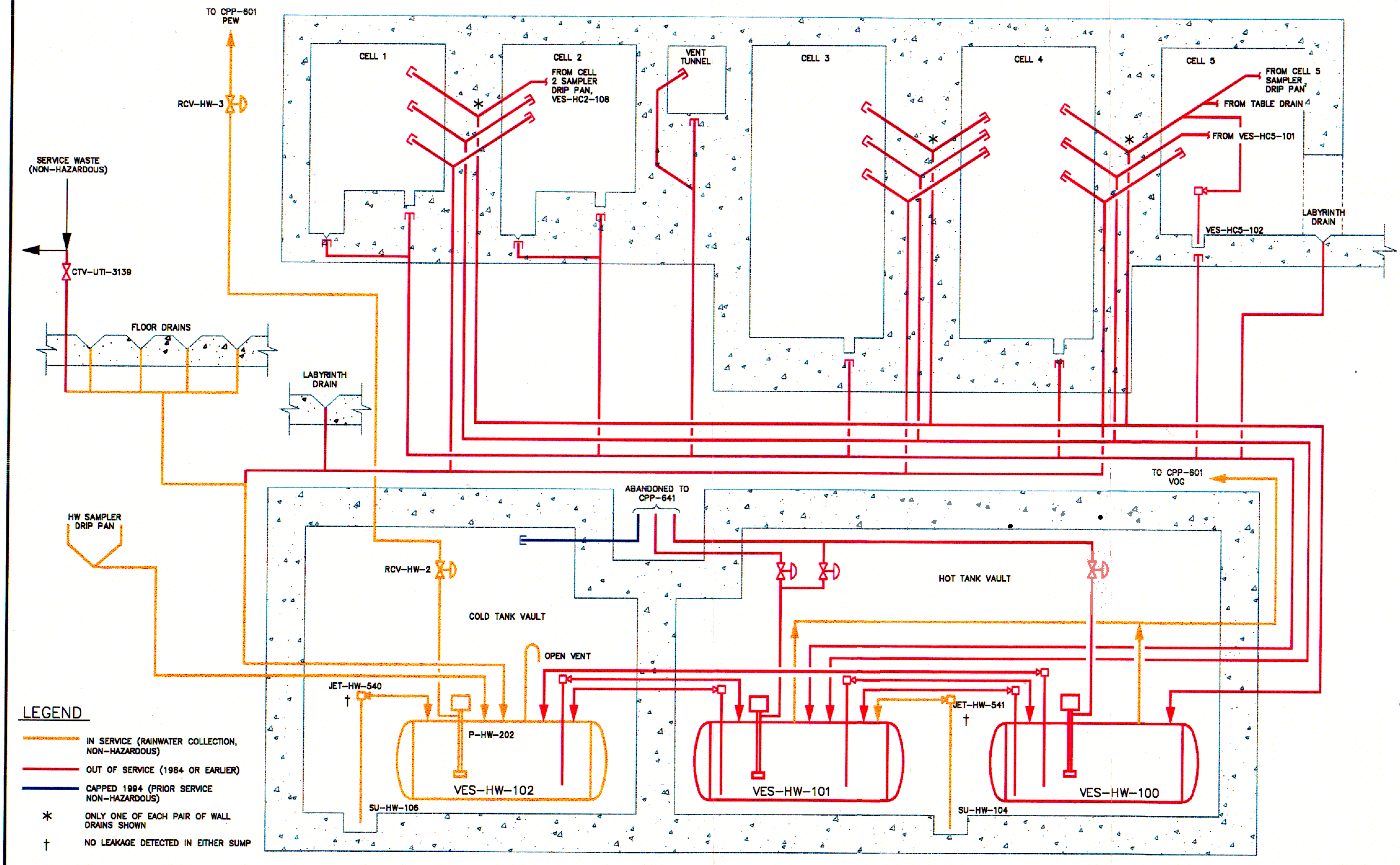


FIGURE 2-8

CPP-640 WASTE COLLECTION TANKS AND ANCILLARY PIPING

The concrete walls, ceilings, and floors of the waste tank vaults were painted with epoxy paint. Documentation on paint type and application was not sufficient to claim full compatibility with nitric acid solutions. Leak detection was provided by a box-type sump in each vault.

Wastes collected in the CPP-640 tanks were sampled and then pumped to the tanks in CPP-641 (Westside Holdup Storage Tanks) before transfer to the PEW evaporator system. The buried lines to CPP-641 were encased with vitrified clay tiles, which are not fully compatible with nitric acid solutions.

The CPP-640 facility was not often used for experimental purposes. One of the early process tests was successful enough to be made permanent, and Cell 5 was dedicated to the Electrolytic process for dissolving stainless steel clad fuels. Later, Cells 2, 3, 4, and the MHC were dedicated to the Rover process for graphite based fuels. This shift in function was reflected in the new designation as the 'Headend Process Plant'. At about the same time, the plant areas which had originally been uniformly labeled HPP, were subdivided into HCC, HC1, HC2, HC3, HC4, HC5, HM, HA, HO, HS, HV, and HW. Confusion has occurred because many documents with reference to the original HPP designations were not updated.

Both the Electrolytic and Rover processes generated only uranium product streams. The waste collection tanks had no recycle capability, and very limited facility for chemical adjustments. Collection in the hot waste tanks was limited to decontamination efforts. Corrosivity characteristic and chromium toxicity characteristics were the only RCRA concerns in these solutions. The cold waste tank was used to collect rainwater and floor washing solutions from the operating areas. These solutions were non-hazardous.

When buried waste lines at the INTEC were replaced (1990-91), no cost-effective means of replacing the waste piping under CPP-640 could be identified. The portions of the system leading to and from the hot tanks (HW-100 and HW-101) were taken out of service. The last recorded use of the tanks was in 1984, and the tank levels had been reduced to below the level probes, samplers, and transfer piping. Since the tanks have been under continuous off-gas system vacuum, they are most likely completely dry. Radiological conditions around the tanks in the hot tank vault are unknown. Access to the hot vault is very difficult, and no known entries have been made to the area in the last twenty years.

Since rainwater leakage into the building was a continuing problem, the cold waste tank, HW-102, had to remain in service. The cold tank vault was entered and inspected, and the transfer line from HW-102 was rerouted to the CPP-601 PEW collection system. HW-102 was sampled and found to contain no hazardous waste. The HW-102 collection system was reduced to a minimum, and the restriction to non-hazardous materials only was continued.

The tank vault sumps, HW-104 and HW-106, have never collected liquid from process leaks or rainwater in-leakage.

2.4 Abandoned Tanks and Piping Description

During the course of changing operations, a number of vessels and piping were found to be unnecessary for future use. Sometimes such vessels and piping were completely removed. In other cases, the risks involved (primarily radiological) in removing the vessels and piping were judged too high, so the equipment was abandoned in place. Abandonment consisted of cutting and capping all (or most) lines leading to or from the vessel, removing or disabling of any solution transfer equipment, removal of instrumentation, and (usually) removing the connection to the off-gas system. Piping runs were normally capped to prevent contamnation spread, but sometimes one or both ends of a pipe were left open.

All work involved in abandoning a vessel or piping was done by hands-on methods, so a thorough decontamination of the equipment was required. Decontamination was also required to minimize future exposure to workers who may have maintenance tasks on other equipment nearby. Prior to chemical decontamination, the vessels would have been flushed and sampled to assure that all uranium had been removed. This requirement was driven by nuclear criticality concerns and the need for accurate uranium accountability. For a historical perspective, more than 120 vessels were given equivalent cleaning to that used on the abandoned vesssels prior to removal from the FRC. A similar proportion of piping was also removed, ~5 to 1 compared to that abandoned in place.

2.4.1 Abandoned Vessels

Most vessel abandonments occurred before RCRA laws were written, and all occurred before RCRA requirements were enforced at the INEEL. This means that no samples were taken to check for hazardous residues. It is unlikely that these vessels pose any appreciable risk to the environment, since the major likely hazard is small amounts of residual acid. For comparison, dissolver vessel VES-E-151 would have had contact radiation readings in excess of 1000 rem/hr during operation. When emptied of process solution and water rinsed, radiation fields over 100 rem/hr would be expected. After chemical decontamination, flushing, and emptying, the vessel now reads about 0.1 rem/hr.

A brief description will be given for each of the abandoned vessels in CPP-601 and CPP-640. The total estimated residual volume is less than 17 gallons for all abandoned vessels.

VES-E-105

This small vessel was used to monitor dissolver product feed rate from the old STR/SIR process, last used during 1965. The only remaining connections to the vessel VOG and an air sparge. Since the vessel originally had a bottom drain and has been under VOG vacuum for over 25 years, the vessel residual contents are probably dry. There was a significant radiological hot spot at the vessel bottom (8 rem/hr behind shielding).

Construction: 347 stainless steel, 6" Sched 40 pipe
Dimensions: 6" ID, 120" straight side, pipe cap bottom
Volume: 15 gal per print; calculated as 15.1 gal
Estimated residual volume: 0 gal
Method of emptying: pump from bottom drain
RCRA concern: corrosivity characteristic

VES-E-151 (VCO)

This vessel was used to dissolve fuel in the old STR/SIR process, last used during 1965. The only functional connections to the vessel are the decontamination lines and charging chute from the process makeup (PM) area. This vessel had a small diameter for criticality concerns, so the initial solution heel would have been less than two liters. The vessel reads approximately 0.1 rem/hr. The vessel is surrounded by a heating/cooling jacket, which contains non-hazardous steam condensate or water. VES-E-151 is connected to it's condenser E-351.

Construction: ½ " thick Carpenter 20 (a Niobium stabilized stainless steel)
Dimensions: 4.5" ID for bottom 15", 5.625" ID for 223.5" to offgas outlet
Volume: 30 gal per print; calculated as 25.2 gal (max operating volume)
Estimated residual volume: 0.25 gal
Method of emptying: side mounted steam jet
RCRA concern: corrosivity characteristic

VES-HC2-151 (VCO)

This annular vessel was designed to dissolve Rover fuel, but the vessel lining failed during cold testing. The vessel was rinsed and all process connections, except the off gas, were blinded during 1983. The vessel itself has no radioactive contents, but is located in a contaminated cell with approximately 0.05 rem/hr fields. Since the vessel has been under VOG vacuum for 15 years, it is likely dry. The vessel is surrounded by a water jacket, which contains non-hazardous material.

Construction: Kynar-lined steel, ½" metal, 0.06" Kynar
Dimensions: Annulus 21" OD, 13" ID, 115" straight side; nested cone bottom
Volume: calculated 106.6 gal for annulus, 5.9 gal for cone, 112.5 gal total
Estimated residual volume: 0 gal
Method of emptying: pump from bottom drain
RCRA concern: corrosivity characteristic

VES-H-120A and VES-H120B

These small interconnected vessels served as a phase separator to decant possible first cycle organic solvents (non-hazardous TBP/kerosene) from solutions being routed to the old uranium salvage system. External connections, except for two decontamination lines, have been removed. The vessels were rinsed and emptied prior to abandonment, leaving a probable residual of less than 1 liter (0.25 gallons). Cell radiation fields are about 0.05 rem/hr.

Construction: 347 stainless steel, 5 ¼" tube
Dimensions: 5" ID, A – 60" straight side, B – 26" straight side
Volume: per print: A - 4.5 gal, B - 3.3 gal; calculated: A - 5 gal, B - 2.3 gal
Estimated residual volume: 0.25 gal
Method of emptying: steam jet from bottom drains
RCRA concern: corrosivity and mercury characteristics

VES-J-117 (VCO)

This vessel was used to collect any hexone that may have condensed from the overhead vapor stream leaving the old uranium salvage evaporator, J-125. The vessel was flushed and emptied before isolation, leaving a probable heel of less than two liters (0.5gallon). The vessel was isolated during the late 1980's. It has no radiation readings above the cell background (0.005 rem/hr).

Construction: 347 stainless steel, ¼" thick
Dimensions: 36" OD, 38" straight side, inverted dish bottom
Volume: calculated as 200 gal
Estimated residual volume: 0.5 gal
Method of emptying: top mounted steam jet
RCRA concern: corrosivity and hexone characteristics

VES-J-131 (VCO)

This vessel served as the phase separator for the condensed overhead vapors from the old uranium salvage evaporator, J-125. The vessel was designed to retain a volume of aqueous solution of 11.8 gallons. Any hexone would float off the water layer to VES-J-117; excess aqueous went to PEW via an underflow weir. There is no provision to drain this aqueous layer except by cutting into the vessel bottom. J-125 condensates at times were dilute nitric acid, which would have exceeded the limit of pH 2. It has no radiation readings above cell background.

Dimensions: 8" ID, 72" straight side, pipe cap bottom
Volume: 16.8 gal per print; calculated as 16.4 gal
Estimated residual volume: 11.8 gal
Method of emptying: gravity flow from side nozzle, cannot drain below that level
RCRA concern: corrosivity and hexone characteristics

VES-PA-102 (VCO)

This small vessel served as both a sump for the old access corridor centrifuge area and as an airlift pit to provide the necessary submergence ratio for the centrifuge product airlift. It was emptied and flushed for uranium prior to abandonment. Transfer jet and airlift piping were removed, a stainless steel plate was welded over the top, and a 16" thick slab of concrete was poured over the whole area formerly occupied by the centrifuge for radiation shielding. The residual volume is estimated to be about 1 liter (0.25 gal). The bottom 10 feet of this 5" diameter vessel hangs down into the waste trench. The bottom read 1.5 rem/hr at contact.

Construction: 304L stainless steel, 5" Sched 40 pipe
Dimensions: 5" ID, 137" straight side, pipe cap bottom
Volume: calculated as 11.9 gal
Estimated residual volume: 0.25 gal
Method of emptying: top mounted steam jet
RCRA concern: corrosivity and mercury characteristics

VES-S-115

This vessel once collected the third cycle product from Q-110. It was thoroughly flushed to remove uranium. The vessel was emptied through its bottom drain, so the residual solution volume is near zero. All piping to the vessel has been removed or capped. The S-cell radiation field is about 0.02 rem/hr.

Construction: 347 stainless steel, 5 ¼" tubing, 0.134" thick
Dimensions: 5" ID, 120" to inlet
Volume: calculated as 10.3 gal (max operating)
Estimated residual volume: 0 gal
Method of emptying: pump from bottom drain
RCRA concern: corrosivity characteristic

VES-U-129 and VES-U-130 (both VCO)

These evaporator vessels were formerly used to concentrate raffinates from the second cycle extraction process. Extensive flushing and decontamination was done on these vessels prior to isolation. The vessels were then emptied to their jet heels, ~2 liters (0.5 gal). The vessels read 0.05 to 0.1 rem/hr. All connections except the decon line have been cut and capped. These vessels are surrounded by steam jackets, which are probably full of non-hazardous condensate. VES-U-129 is connected to it's condenser HE-U-300 (VCO). VES-U-130 is connected to it's condenser HE-U-301 (VCO).

Construction: 347 stainless steel, ¼" thick
Dimensions: 42" OD, 51" straight side, inverted dish bottom
Volume: calculated as 280 gal each
Estimated residual volume: 0.5 gal each
Method of emptying: top mounted steam jet
RCRA concern: corrosivity and mercury characteristics

VES-VT-100 and VES-VT-101

These vessels were vacuum tanks for a vacuum filtration system installed with the first-generation fuel dissolvers in C- and D-cells. The system was not used after the new aluminum fuel dissolvers were installed in G-cell in the early 1960's. During use, the vessels were accidentally contaminated internally by dissolver product. These vessels normally contained no liquid. They were connected to the off-gas vacuum for fifteen years after their last use, before being totally isolated in the middle 1980's. Since the vessels drained to PEW via bottom drains, they are probably completely empty. Radiation fields around the vessels are 0.02 to 0.05 rem/hr.

Construction: 347 stainless steel, 3/16" thick
Dimensions: 24" OD, 48" straight side, dish bottom
Volume: per print 100 gal each; calculated as 99.3 gal each
Estimated residual volume: 0 gal
Method of emptying: gravity bottom drain
RCRA concern: corrosivity and mercury characteristics

VES-Y-140 (VCO)

This vessel was formerly used to concentrate the raffinates from the third cycle extraction process. The vessel was decontaminated, flushed, and emptied to its jet heel prior to isolation. Estimated residual volume is 2 liters (0.5 gal). All lines except the decon line were cut and capped. The vessel reads ~0.02 rem/hr. The vessel is surrounded by a steam jacket, which is probably full of non- hazardous condensate. VES-Y-140 is connected to it's condenser HE-Y-300.

Construction: 347 stainless steel, ¼" thick
Dimensions: 32" OD, 50" straight side, inverted dish bottom
Volume: calculated as 165 gal
Estimated residual volume: 0.5 gal
Method of emptying: top mounted steam jet
RCRA concern: corrosivity characteristic

VES-Y-150 (VCO)

This small vessel was formerly used to collect sample residues from the X-cell laboratory and return them to the uranium salvage process. The vessel was last used during the 1970's. It was flushed and emptied through its bottom drain, so it is probably completely empty. All lines except the off-gas and decon line were cut and capped. The vessel reads ~0.01 rem/hr.

Construction: 347 stainless steel, 0.134" wall tube
Dimensions: 5 ¼" OD, 48" straight side
Volume: calculated as 4.1 gal
Estimated residual volume: 0 gal
Method of emptying: steam jet in bottom drain
RCRA concern: corrosivity characteristic

VES-Y-160 and VES-Y-161 (both VCO)

These vessels were installed for a demonstration project to allow use of third cycle raffinate as first cycle scrub solution. VES-Y-160 was occasionally used through the early 1980's as a surge tank for feed to evaporator Y-140. VES-Y-161 was connected to the bottom drain of Y-160 as a sidearm. Closing the valves between the two vessels allowed the much smaller Y-161 to serve as a pump rate meter. The original drain piping was removed in the 1970's, and connections with Y-140 were removed in the middle 1980's. Prior to abandonment, the vessels were flushed and emptied to the jet heel, which is estimated to be 5 liters (1.5 gallons) in the two vessels and connecting piping. The area around the vessels reads ~0.02 rem/hr.

<u>VES-Y-160</u>

Construction: 304L or 347 stainless steel, ¼" thick
Dimensions: 36" OD, 56" overall height, inverted dish bottom
Volume: calculated as 205 gal
Estimated residual volume: 1.5 gal
Method of emptying: top mounted steam jet
RCRA concern: corrosivity characteristic

VES-Y-161

Construction: 304L or 347 stainless steel, 8" Sched 40 pipe
Dimensions: 8" ID, 48" straight side, pipe cap bottom
Volume: calculated as 11 gal
Estimated residual volume: 0 gal
Method of emptying: bottom drain connects to Y-160
RCRA concern: corrosivity characteristic

VES-P-102A and VES-P-106A

These vessels are spare extraction and stripping columns for the hexone extraction system located in P-cell. The vessels were abandoned prior to 1975. There are no connections to either vessel. The vessels were drained through cut stubs of bottom lines before those lines were capped, so they are empty.

VES-P-102A

Construction: 347 stainless steel tube, 304 stainless steel Raschig ring packing in center section (3/8" x 3/8" rings)
Dimensions: 54" of 5 ¼ " tube heads, 456" 5" tube center
Volume: calculated at 39.2 gal (31 gal allowing for packing)
Estimated residual volume: 0 gal
Method of emptying: gravity through severed bottom drain
RCRA concern: corrosivity and mercury characteristics

VES-P-106A

Construction: 347 stainless steel tube, 304 stainless steel Raschig ring packing in center section (3/8" x 3/8" rings)
Dimensions: 54" of 5 ¼ " tube heads, 294" 5" tube center
Volume: calculated at 26.9 gal (21.3 gal allowing for packing)
Estimated residual volume: 0 gal
Method of emptying: gravity through severed bottom drain
RCRA concern: corrosivity and mercury characteristics

2.4.2 Abandoned Piping

Abandoned piping systems included on plant drawings were included in the Equipment Description Tables in Appendix A. This listing is not complete since some piping abandoned in the early history of the FRC was intentionally removed from the drawings. Some field changes were not documented, in which equipment planned to be removed was abandoned instead. The number of such undocumented piping runs is a small fraction of the total.

The direct buried PEW collection piping under the FRC was abandoned during 1990-91. These pipes were all designed for gravity drainage and should have been empty. All were capped at the upper ends, but ALARA considerations limited the caps at the lower ends to those required for installation of new lines or to isolate known leaks. The lines were not flushed since the attempt could have introduced more waste to the soil. See Section 3.5 for further discussion of this issue.